ACCIDENT PREVENTION AND RESPONSE MANUAL

for

Anhydrous Ammonia Refrigeration System Operators

U.S. Environmental Protection Agency Region 7

March 2006

(Third Edition)
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www.epa.gov/region07/toxics/arpp.htm

What's this Manual All About?

There are many environmental laws and regulations in place to protect operators, other employees, and surrounding communities from the potential hazards of working with toxic chemicals like anhydrous ammonia.

This manual summarizes the requirements of these laws for anhydrous ammonia system operators. A list of the federal laws and regulations related to process safety, accident prevention, emergency planning, and release reporting may be found in Chapter 5.

Many anhydrous ammonia system operators know their systems inside and out. If you are already familiar with the environmental laws and regulations that pertain to your system, then you are invited to test your knowledge by taking the quiz in Appendix F. If you score 100% - CONGRATULATIONS and you may not need this manual. If you score less than 100%, this manual will help you update your knowledge base. Good luck!

Test your ammonia refrigeration knowledge in Appendix F.

This manual has been prepared by the Environmental Protection Agency Region 7 (Iowa, Kansas, Missouri & Nebraska). Region 7 thanks all who contributed their time and expertise to the development of this manual. A special thanks to the final editor, Patricia Reitz, of EPA Region 7.

Notes about this Third Edition:

The first printing of this manual was April 2005. The second printing had minor typographical changes and was printed October 2005. This third printing corrected typographical and formatting errors. In addition, the "Rupture Disc/Dual Relief Valve Assembly" diagram on Page 3-5 was modified. The final change was on Page 3-13 with the addition of the "Thermal Imaging" section.

Disclaimers:

- This manual provides guidance to assist regulated entities in understanding their obligations in accordance with environmental laws. For a complete understanding of all legal requirements, the reader must refer to applicable federal and state statutes and regulations. This manual is not a substitute for regulations, nor is it a regulation itself. Thus, it cannot impose legally binding requirements of EPA, states, or the regulated community.
- This guidance does not represent final agency action and may change in the future, as appropriate.
- This guidance does not limit the otherwise lawful prerogatives of regulating agencies. Agencies may act at variance with this guidance based on facility-specific circumstances.
- Mention of trade names, commercial products, industry references, and technical resources does not constitute an endorsement or recommendation for use.

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CHAPTER 1 - WHAT'S THE BIG EMERGENCY?

1.1 Accidents Happen

Ammonia is used as a refrigerant at a large number of industrial facilities. Industrial facilities that typically use ammonia refrigeration systems include:

- Cold storage warehouses and ice plants,
- Meat, poultry, or fish processing centers,
- Dairy and ice cream plants,
- Wineries and breweries,
- Fruit/vegetable juice and soft drink processing facilities, and
- Petrochemical facilities.

Accidental ammonia releases cause injuries and death to employees, emergency response personnel, and people in surrounding communities. Here are some examples.

Cold Storage Explosion Kills Firefighter

A firefighter was killed and another seriously injured by an explosion at a cold storage warehouse in 1984. Investigators determined the likely cause to be ignition of a hazardous accumulation of ammonia gas. Factors contributing to the loss of life and the extensive property damage included failure of maintenance workers to take precautions to minimize release and accumulation of the ammonia.

Forklift Ruptures Ammonia Pipe

A forklift struck and ruptured an ammonia refrigeration pipe at a meat packing plant in 1992.. Workers were evacuated when a leak was later detected. A short time later, an explosion caused extensive damage, including large holes in two sides of the building. The forklift was believed to be the ignition source.

45,000 Pound Release of Ammonia

A 1989 ammonia release led to the evacuation of nearly 6,500 residents of the town where the plant was located. This release formed a cloud approximately 24 city blocks long. Fifty area residents where treated with oxygen at local hospitals, while dozens more were treated at evacuation centers. This release started when the end cap of a 16-inch suction line was knocked off.

Ammonia Thefts Cause Releases

EPA receives ammonia theft reports every few weeks. Releases during the thefts have injured and killed several people. Valves left open during siphoning, plugs removed from pipes, and wrong hoses, fittings, and containers have caused leaks and spills that would not otherwise occur.

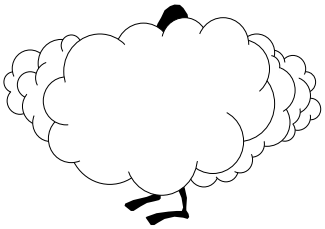
72% of all reported chemical accidents in this Region's 4-State area involve anhydrous ammonia. Up to 96% of them are preventable through increased operator training, improved procedures, and better communication of lessons learned.

(Based on chemical accidents required by EPA to be reported by industry from 1994-2004).

1.2 Why Is Anhydrous Ammonia So Dangerous?

Anhydrous ammonia and ammonium hydroxide are two types of ammonia commonly used in industry. This manual will focus on the "anhydrous" type, which means, "without water." (*Ammonium hydroxide is formed when ammonia gas is dissolved in water.*)

Anhydrous ammonia is very corrosive, and exposure to it may result in chemical-type burns to skin, eyes, and lungs. It may also result in frostbite, since its boiling point is -28°F. Ammonia is *hygroscopic*, which means it has a high affinity for water, and migrates to moist areas like the eyes, nose, mouth, throat, and moist skin.



Released anhydrous ammonia will rapidly absorb moisture from air and form a dense, visible white cloud. This dense cloud tends to travel along the ground on a cool day. **Do not enter a visible cloud of ammonia. It will damage your lungs.**

If there is no visible cloud, you can still detect an ammonia release by it's pungent odor when it is present in the concentration of 5 to 50 parts per million (ppm*). Exposure to anhydrous ammonia between 5 and 50 ppm can cause **headaches**, **loss of the sense of smell**, **nausea**, and **vomiting**. Concentrations above 50 ppm result in **irritation to the nose, mouth, and throat causing coughing and wheezing**. Concentrations of 300 to 500 ppm are immediately dangerous to life and health. People will generally leave the area due to **lung irritation**, **coughing**, and **shortness of breath**. Higher exposures can cause **fluid in the lungs** (pulmonary edema), and severe shortness of breath.

Ammonia is also flammable and explosive. It can be ignited by something as common as the electric flash from a switch.

Refer to Appendix C for Emergency First Aid for Ammonia Exposure.

The best first aid is to prevent the injury in the first place. Preventing accidents not only keeps employees healthier and more productive, it saves a lot of wasted time and money from having to repair equipment, pay for injured employees' medical expenses, lost product, and having to clean up the mess. Chapter 3 discusses how to **prevent accidents.**

**An example of parts per million (ppm) is one (1) needle in a 2000 pound haystack.*

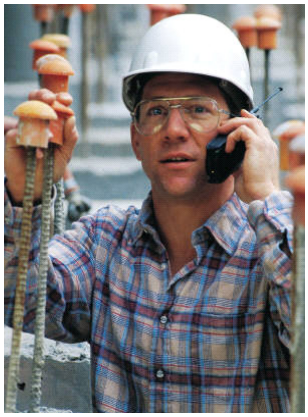
CHAPTER 2 - IS MY FACILITY A SAFETY RISK?

2.1 Determine Your Responsibility

Keeping employees, emergency workers, and the surrounding community safe is of utmost importance. Therefore, Congress has enacted laws requiring hazardous chemical facilities to prevent accidents and respond to emergencies that might occur.

Under Section 112(r) of the Clean Air Act (CAA) and Title 40 of the Code of Federal Regulations (CFR), Part 68, owners and operators of stationary sources are required to develop Risk Management Programs **for each regulated substance** in a process. The goal of EPA's Risk Management Program is to prevent or minimize consequences of accidental releases of certain hazardous substances.

Compliance with 40 CFR 68 is required if the facility has more than the **threshold quantity** of a regulated substance in a process (including storage) at any given time. 40 CFR 68.130 lists the threshold quantities of regulated substances and the basis for their listing (i.e., toxic or flammable). Facilities subject to 40 CFR 68 were to be in compliance by June 21, 1999, or the date when the facility first had over the threshold quantity of a substance in a process, whichever was later. **The threshold quantity for anhydrous ammonia** (CAS#7664-41-7) **is 10,000 pounds, which is approximately 2000 gallons.**



If you aren't sure whether this rule applies to your facility, call the EPA HOTLINE at: (800) 424-9346 or (800) 553-7672 (TDD).

If you find that one or more of your processes are subject to this rule, you will likely need to develop an accident prevention program and an emergency response program. In order to develop the correct level of prevention program, you will need to determine whether your facility is subject to Program 1, Program 2, or Program 3. Appendix A will help you determine your program level and corresponding responsibilities.

If your facility is subject to this rule, see Appendix A

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CHAPTER 3 - PREVENTING ACCIDENTS

3.1 Work Safely

As mentioned in Chapter 1, ninety six percent of accidents reported in Region 7 (Iowa, Kansas, Missouri, and Nebraska) are preventable through increased operator training, improved procedures, and better communication of lessons learned. **A major component of working safely is to develop and implement "Best Practices" at your facility**. Best practices are intended to help facility engineers and operators:

- Learn from experiences of other facility engineers and operators;
- Encourage proactive measures to minimize and prevent releases from anhydrous ammonia refrigeration systems;
- Recognize specific actions taken to improve process safety, prevent accidents, and enhance emergency planning and response efforts; and
- Be better prepared to help facility managers understand and approve the efforts required to incorporate these and other best practices.

Under the Clean Air Act Section 112(r)(1), facilities, including anhydrous ammonia facilities of any size, have a general duty "to prevent releases, and to minimize the consequences of accidental releases which do occur." Implementing "best practices" helps facilities to comply with this law.

System Design, Modification, and Protection

Personnel at ammonia refrigeration facilities should be aware of the hazards associated with anhydrous ammonia releases and the measures that can be taken to prevent such releases. It is important to consider the chemical characteristics of anhydrous ammonia when determining appropriate accident prevention measures. Here are steps that ammonia refrigeration facilities could take to prevent releases and/or reduce the severity of releases should they occur.

Find locations for installing "Self-Closing" Valves

Using a spring-loaded 1/4 turn ball or globe valve ("self-closing" valve) with an oil drain container is considered a best practice. A "self-closing" valve functions as an emergency stop valve to prevent an ammonia release if the operator draining oil is overcome or must abandon his work station. As an alternative, the International Institute of Ammonia Refrigeration recommends "quick turning" ball valves instead of the self-closing valves. Regardless of which type of valve is used, maintenance staff should not leave these valves unattended during oil drain-off procedures.

"Self-Closing" Valve (Dead Man Valve)

Protect Equipment, Tanks, Piping

Forklifts, hand trucks, and other maintenance vehicles can and have caused ammonia releases after damaging unprotected components of ammonia refrigeration systems. It is good practice to provide barriers or establish safety procedures to protect refrigeration equipment (e.g., pipes, valves, evaporator coils, tanks, vessels, etc.) likely to be damaged.

Examples of how facilities are protecting refrigeration equipment include:

- Warning signs;
- Bang plates;
- Photo beams;
- Incorporating warning devices in forklifts;
- Suspending PVC pipes and cowbells below ceiling mounted evaporator coils;
- Installing horizontal and vertical structural members to prevent products on pallets from falling against refrigeration equipment;
- Blocking access to storage bins immediately adjacent to and below refrigeration equipment; and
- Installing concrete curbs, barriers, bollards, or aprons to prevent wheeled equipment from impacting equipment.

Install bollards to protect tanks, lines, valves and coils from forklift impact.

Install, Maintain, and Inspect Ammonia Detector Systems

It is good practice to use ammonia detectors to help monitor anhydrous ammonia systems for leaks. Consider installing detectors in areas where a leak could occur or an area which is not manned 24 hours per day and 7 days a week. The detectors could be monitored by a local alarm company or linked into an automated system that contacts offsite personnel. Operation of ammonia sensors and alarms should be checked and calibrated regularly to ensure the alarms are set to alert personnel of a release.

The following are examples of detector problems that have been noted during inspections:

- Ammonia detectors were calibrated to alarm at 600 ppm, twice the IDLH (immediately dangerous to life and health) level;
- Ammonia detectors did not function properly; and
- Ammonia detectors were not properly calibrated.

Ammonia detectors should be calibrated every six months with the alarm set at or below 50 ppm for detectors located out of the engine room. Ammonia detectors located in the engine room should trigger the alarm at or below 300 ppm.

Facilities have also used ammonia detector signals to activate ventilation fans in compressor rooms and to trigger remote alarms to notify facility security personnel about accidental releases of ammonia.

In order for the alarm to be protective within the facility's operation, the alarm **set points** should be site specific and range specific. Each alarm should also activate a call down system that alerts key ammonia refrigeration personnel. Please see the example to the right.

Alarm	Set Point	Alarms/Actions
Caution	30-60 ppm	Local alarm horns & strobe lights. Call down system on.
Warning	60-130 ppm	Alarm Horns & Strobes. Vent fans activate. Call down system on.
Alarm	130-225 ppm	Alarm Horns & Strobes. Vent fans activate. Automated announcement. Ammonia compressor shuts down. Call down system on.

Constant ventilation in a machinery room is an option available in place of ammonia detection devices per the American National Standards Institute/American Society of Heating, Refrigerating and Air-Conditioning Engineers 15-1994 Safety Code for Mechanical Refrigeration. Paragraph 8.14(h) states:

"When ammonia is used, the machinery room is not required to meet Class I, Division 2, of the National Electric Code providing:

- The mechanical ventilation system in the machinery room is run continuously and failure of the mechanical ventilation system actuates an alarm; or

- The machinery room is equipped with a vapor detector that will automatically start the mechanical ventilation system and actuate an alarm at a detection level not to exceed 1000 ppm.

Install Check Valves in Ammonia Charging Line
Facilities should consider installing a manual check valve in the ammonia charging line in a location close to the main control valve. This check valve can be used to isolate any problems associated with the main control valve and prevent release or removal of ammonia through the charging line.

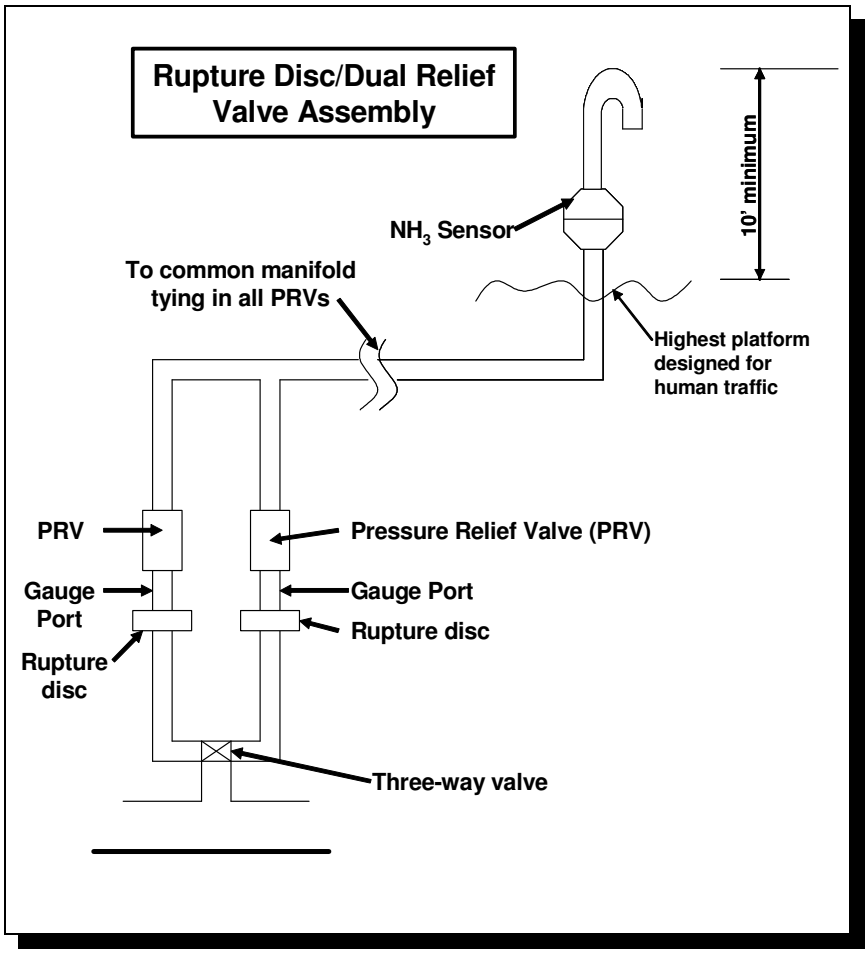
Configure Remote Operation of Solenoid Valve on King Valve Line
It is best to install a solenoid valve in the King Valve line near the receiver vessel and configure operation by a manual switch located outside of the compressor/recycle room. The system's manual kill switch should also be clearly recognizable by all facility personnel and emergency responders.

Install Dual Relief Valves
Facilities are replacing single **pressure relief valves** (PRVs) with dual relief valves to facilitate the maintenance of relief valves. Installation of a dual relief valve consists of one three-way shut-off valve and two pressure safety release valves. The American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)'s Standard 15, *Safety Code for Mechanical Refrigeration*, outlines the required use of dual pressure relief valves.

Use of dual relief valves and a three-way valve allows one relief valve to be serviced, tested, or replaced, while the other PRV remains on-line to protect the refrigeration equipment. This configuration enables the operator to keep the refrigeration system operational rather than needing to pump down the equipment each time a relief valve is serviced or replaced. Each valve must be of adequate size to protect the refrigeration equipment.

Large Systems with Multiple PRVs

For large systems with many PRVs, consider using the arrangement shown below for detecting leakage. This arrangement includes installation of a rupture disc upstream of each PRV with a gauge port or transducer in between the disc and PRV and installation of an ammonia sensor in the PRV common manifold. In case of leakage from a PRV, the sensor would set off an alarm. A check of either the pressure gauge, rupture disc, or transducer signal would permit easy identification of which PRV has popped.



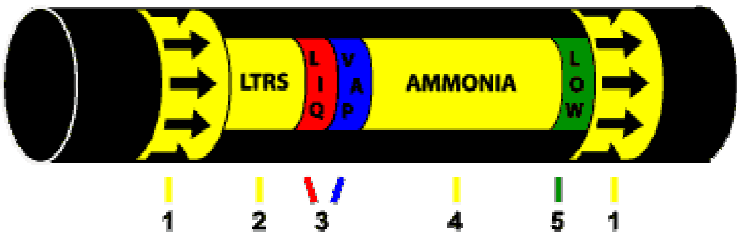
Install Emergency Ventilation Switches

Some facilities have installed manual switches to remotely activate ventilation fans. Others have their ammonia detectors activate the fans at a certain parts per million (ppm) level, and some facilities use continuous ventilation. It is recommended to have the remote switches located near, yet at a safe distance from, the compressor room. Identify the switch(es) with signage for use in an emergency.

Emergency Control Switches

Color Coding and Labeling

Using a color-coding and/or a labeling system helps to ensure the facility's engineering drawings or piping and instrumentation diagrams (P&IDs) are up-to-date and reduces the chances of errors in the facility's operating procedures. One generic example could be as follows:



1. **Use arrows to indicate the direction of ammonia flow.**

2. **Use abbreviations to properly identify system components**.

3. **Indicate whether the refrigerant is a liquid, vapor, or both.**

   - Orange color band indicates liquid state
   - Blue color band indicates vapor state
   - Use both color bands to indicate both states are present

4. **Print "Ammonia" in black letters on yellow background.**

5. **Indicate whether the internal pipe pressure is high or low.**

   - Red color band indicates high pressure
   - Green color band indicates low pressure

Facilities that lack clear and comprehensive labeling are "accidents waiting to happen."

All piping, valving, and instrumentation should be uniquely identified as illustrated in Section 11.2.2 of ANSI/ASHRAE 15 (1994).

ANSI/ASHRAE 15 (1994)
Safety Code for Mechanical Refrigeration; Section 11.1.2, Controls and Piping Identification

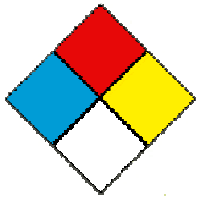
"Systems containing more than 110 lb (50 kg) of refrigerant shall be provided with durable signs having letters not less than 0.5 in. (12.7 mm) in height designating:

(a) valves or switches for controlling the refrigerant flow, the ventilation, and the refrigeration compressor(s), and

(b) the kind of refrigerant or secondary coolant contained in exposed piping outside the machinery room. Valves or piping adjacent to valves shall be identified in accordance with *ANSI A13.1, Scheme for Identification of Piping Systems*."

Some examples include:

- Select and post the facility's marking and labeling system for it's components and piping.
- Identify the chemicals within the piping system(s) using a color coding system (e.g., ammonia, new or used oil).
- Identify the king valve and all other emergency isolation valves with large, easily identifiable placards to be used in an emergency.
- Clearly and consistently indicate the king valve and all other emergency isolation valves on the piping and instrumentation diagrams (P&IDs) and any process flow or control logic diagrams.
- Post ammonia placards (i.e., National Fire Protection Association 704 NH_3 diamond) and warning signs in areas where ammonia is being used as a refrigerant or is being stored (e.g., compressor room doors).



NFPA diamond

- Distinguish and label storage cabinets used for emergency response equipment, supplies, and reference materials.
- Field verify line and labeling accuracy using current update of the systems P&IDs.
- Consider whether signs should be posted in other languages in addition to English.

SYSTEM OPERATIONS AND MAINTENANCE

Develop Operating Procedures

Operating procedures should be developed and implemented in accordance to 40 CFR 68.69, "Operating Procedures". Refrigeration operators and maintenance personnel should review and follow the facility's operating procedures before performing routine tasks (e.g., adding ammonia, replacing a PRV, etc.).

Here are some helpful resources for developing operating procedures:

- ***American National Standard: Safety Code for Mechanical Refrigeration***, ANSI/ASHRAE Standard 15, 1994.

- ***Guidelines for: Suggested Safety and Operating Procedures When Making Refrigeration Plant Tie-Ins***, IIAR Bulletin 107, 1997.

- ***Guidelines for: IIAR Minimum Safety Criteria for a Safe Ammonia Refrigeration System,*** IIAR Bulletin 109, 1997.

- ***Guidelines for: Start-Up, Inspection, and Maintenance of Ammonia Mechanical Refrigeration Systems***, IIAR Bulletin 110, 1993.

Develop and Maintain Preventative Maintenance Program

In accordance with 40 CFR 68.73, "Mechanical Integrity", procedures must be written and implemented to maintain the ongoing integrity of process equipment. A preventative maintenance program and schedule, based on the manufacturer's recommendations, should be prepared for each component of a refrigeration system.

Monitor Refrigeration System Operating Parameters

The ammonia refrigeration system should be routinely monitored. Many facilities use a Daily Engine (compressor) Room Log for recording the refrigeration system's various process temperatures, volumes, vibrations, lubrication levels, and pressures at least once per operating shift. Startup, shutdown, and pump-down operations, as well as the results of any work or testing, should be recorded in the daily log.

Operators should regularly review these logs to watch for trends that may indicate system problems (e.g., increasing system temperatures and pressures, decreases in oil pressure, or releases of ammonia through PRVs). A defective PRV valve can mean the difference between a minor release or a major release. Some facilities have the chief engineer, the plant manager, and a refrigeration technician sign the daily logs to help initiate early, proactive problem resolution. During design of new systems or retrofitting of existing systems, most facilities are using computer controls to monitor, record, and alarm process parameter conditions 24 hours per day.

Equipment manufacturers and equipment operating manuals should be consulted to develop and expand operating logs to ensure their usefulness at each unique facility. A best practice within an operating log is to include a column to document operating conditions. Record whether conditions are normal or not. If conditions are not normal indicate levels and trends that should be addressed through maintenance or emergency actions.

Track Ammonia Purchases and Distribution of Ammonia in Your System

Keep an accurate record of the initial amount of ammonia purchased and any additional replacement charges of ammonia. This data is not only critical for trend and operations analysis, but it is also necessary to determine if system-wide ammonia releases are occurring. If your facility uses more than 10,000 pounds of ammonia in a calendar year, you may be required to report it in accordance with 40 CFR 372 (See page 5-3). Here is an example spreadsheet for tracking ammonia distribution in a system:

Component/Unit	HP NH_3 Receiver V-1	Pilot Receiver V-2	Low Temperature Suction Trap V-3	Intercooler V-4	Accumulator for #1 V-5	Recirculator Vessel V-6
Orientation	Horizontal	Horizontal	Vertical	Horizontal	Horizontal	Horizontal
Diameter (ft)	3.50	1.67	4.00	4.00	3.00	4.00
Length (ft)	18	10.75	8.5	8.0	14.83	12.33
Volume (ft^3)	165.44	23.45	102.04	100.53	104.83	154.98
Liquid Level (%)	35.71%	93.02%	11.76%	22.92%	44.44%	56.25%
Temperature (^oF)	95	95	-31	17	17	-31
Liquid (ft^3)	59.09	21.82	12.00	23.04	46.60	87.18
Liquid (lbs/ft^3)	36.67	36.67	42.69	40.57	40.57	42.69
NH_3 Liquid (lbs)	2,167	800	512	935	1,891	3,722
Vapor (ft^3)	106.35	1.64	90.04	77.49	58.25	67.80
Vapor (lbs/ft^3)	0.6517	0.6517	0.05134	0.159	0.159	0.05134
NH_3 Vapor (lbs)	69	1	5	12	9	3
Total NH_3 (lbs)	2,236	801	517	947	1,900	3,725

Refrigeration Oil

For proper system maintenance, refrigeration oil should be removed from the refrigeration system on a regular basis. The presence of excessive refrigeration oil in the refrigeration system will only be realized if a facility is recording the volume of oil added and removed. Extreme caution should be taken to ensure that oil is never directly removed from a refrigeration system without first pumping down and properly isolating that component. **Since this procedure may be the most dangerous function an operator performs on a regular basis, a facility should seriously consider the installation of 1/4 turn, self-closing ball or globe valves (dead-man valves) at all oil draining points to prevent possible accidents during an oil draining procedure.**

Pressure Relief Valve

Schedule Replacement of Pressure Relief Valves (PRVs)
PRVs should be replaced on a regular schedule, at least every 5 years. ANSI/IIAR's Standard 2, *Equipment, Design, and Installation of Ammonia Mechanical Refrigerating Systems*, should be consulted to plan replacement of PRVs. When replacing PRVs, a facility should also document the replacement dates by date stamping each PRV's tag as well as by placing an appropriate entry in the equipment log. Inventories should then be checked to determine if replacement valves are available in the event of a PRV malfunction.

Maintain Good Housekeeping Practices
Ensure good housekeeping procedures are followed in the compressor/recycle rooms and in the immediate vicinity of the evaporators. Accumulated supplies, equipment, and debris delay detection of equipment damage or ammonia leaks.

Anhydrous ammonia is very corrosive to copper, brass, and galvanized surfaces and materials. Copper, brass, and galvanized components should not be present in any part of an anhydrous ammonia refrigeration system. Support structure components should be readily visible such that they can be inspected for deterioration and replaced before a failure event can occur. The vulnerable metals used in proximity to ammonia should be protected with an appropriate coating. All refrigeration piping should be periodically inspected for failed insulation/vapor barrier, rust, and corrosion. Ammonia piping underneath failed insulation should be carefully inspected for corrosion.

Damaged and deteriorated ammonia piping should be replaced. All uninsulated piping should be cleaned, primed, and painted with appropriate coating to protect the pipe from corrosion as well as being consistent with the color coding scheme.

Piping and Instrumentation Diagrams

Facilities should maintain complete and accurate **piping and instrumentation diagrams** (P&IDs) of the ammonia refrigeration system and the equipment manufacturer's documentation. A P&ID is a set of drawings or detailed schematics that illustrate all components (e.g., vessels, valves, pumps, piping, pressure relief valves) of the refrigeration system. Manufacturer's documentation should describe the operation and control features which are integral to the process. Operating procedures, operation and maintenance checklists, daily logs, a facility's management plan, and emergency response materials should all relate to the information found in the manufacturer documentation and on the facility's P&IDs.

Unfortunately, many facilities have P&IDs that lack critical elements, or do not represent the current operating configuration and system components. These errors cause operating errors, delay efforts to minimize an ammonia release, and further increase the risks to emergency responders.

P&IDs should also be carefully and completely verified while tracing ammonia throughout a facility. Construction changes, system renovations and repairs, and draftsman errors all contribute to inaccuracies in P&IDs. Many facilities find that P&ID verification coupled with a line-and-valve-labeling project is a very cost effective housekeeping project. Ladder/logic diagrams should then be prepared from the verified P&IDs and electrical drawings for all system components.

The following is essential P&ID information:

- All process chemical-containing equipment (e.g., pressure vessels, compressors, condensers, evaporators, pumps);
- Essential valves (e.g., PRVs, isolation valves, remotely operated valves, control stations);
- Controls (e.g., regulators, float switches, solenoid valves, temperature and pressure cutoffs, emergency release cutoff valves);
- Permanent instruments and sensors (e.g., pressure transducers, meters, gauges);
- Equipment and valve numbers;
- Permitted-flow direction on all check valves;
- Piping sizes, reducers, and block valves; and
- Legend of symbols and abbreviations, including date of issue and series of revisions.

Conduct a Periodic Process Hazard Analysis

Facilities are required to review the hazards associated with the regulated substance(s) to look for opportunities for equipment malfunctions or human errors and identify steps needed to monitor or detect releases. This review is often referred to as a process hazard analysis (PHA). PHAs help minimize releases and provide a forum for ammonia system operators to share critical operating knowledge.

A PHA is required every five (5) years or sooner if the facility incurs a major change (40 CFR 68.50(d) & 68.67(f) and 29 CFR 1910.119). A PHA conducted under the OSHA Process Safety Management standard can be used as a facility's initial PHA since OSHA PHAs were to have been completed by May 1997. A well designed PHA should identify all failure scenarios that could lead to significant ammonia exposure of workers, the public, or the environment. The facility must keep all PHAs for the life of the process. Referring to former PHAs ensures that past errors are not repeated and assists with the process of keeping the PHA current.

Here is an example of a PHA Worksheet:

Example Process Hazard Analysis Worksheet

What if	Hazard	Consequences	Safeguards	S	L	R	Recommendations	By
Drain valve open/leaking on lowest vessel	Potential release of ammonia from leak point	Significant volume of ammonia release into engine room	Log vessel operating parameters every 4 hours. Ammonia alarm starts ventilation fans.	2	3	6	Ensure operator regularly checks that caps and plugs are placed on system and protected from damage	JF
Manual valve closed in pump discharge line	Potential for high pump discharge pressures	Over pressurize system, which could lead to ammonia release in engine room	Pressure regulator (vented back to ultra low vessel) is in pump discharge line. Logs of pressure every 4 hours.	1	4	4	Consider providing a PRV on the discharge of pump	GH
Pump stops (due to mechanical failure or low level switch)	Loss of ammonia flow to evaporators	No safety or environmental consequences (operation issue)	Preventative maintenance program and operator attention during ammonia system operations.	4	2	7	No recommendations	MS
Oil lubrication system fails	Ammonia discharge temperatures increase	Compressor bearings or seals could be damaged	Compressor parameters and oil pressure logged every 4 hours. Compressors equipped with low oil pressure alarms and cutouts.	3	3	7	No recommendations	CW
Excessive vibration of compressor or pumps	Damage to compressor or pumps	Potential for catastrophic ammonia leak	Ammonia detector in engine room will alarm and start ventilation fans at 100 ppm setpoint	2	3	6	Consider conducting regular vibration analysis of the compressors and pumps	BW

SYSTEM INSPECTIONS

Conducting any type of inspection is one of the system operator's most valuable tools for preventing unnecessary accidents due to equipment failure.

Conduct Visual Testing

Visual inspections are relatively inexpensive and provide a great deal of valuable information to the system operator. To monitor the condition of the ammonia refrigeration system, the person inspecting the system should note any corrosion of piping, valves, seals, flanges, and other pertinent equipment. In addition, the insulation should be visually inspected for breeches in it's integrity. The person conducting the visual test should keep a log, including photographs, of all findings.

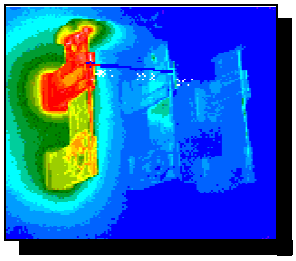
Conduct Leak Testing

All ammonia refrigeration system operators should try to maintain a leak-free ammonia system. Recommended practice involves leak testing all piping, valves, seals, flanges, and other pertinent equipment at least four times a year. Some methods that can be used for leak testing are sulfur sticks, litmus paper, or a portable meter equipped with a flexible probe.

Operators, maintenance personnel, and other facility workers should be encouraged to **immediately report ammonia odors**. Facilities should immediately investigate all reports of ammonia leaks, and take corrective actions without delay.

Conduct Vibration Testing

Depending on the nature of equipment at the site, some facility operators may elect to perform vibration testing on rotating equipment (i.e., compressors and pumps). These are usually performed to supplement the maintenance practices to indicate when equipment overhauls should be performed. Vibration levels on certain equipment can be logged and analyzed to determine if abnormal trends are developing or if further inspections are warranted. Excessive vibration can lead to potential equipment damage which could increase the probability of an ammonia release. The equipment manufacturer should be consulted to provide guidance on the usefulness of vibration monitoring for their particular equipment.



Infrared image of disconnect switch

Conduct Thermal Imaging

A growing trend in preventive maintenance is the use of infrared (thermal) imaging. Infrared thermography helps locate many problems in their early stages often before they can be seen or found in any other way. A temperature difference, usually an abnormal hot spot, is typically associated with these problems due to high electrical resistance or excessive friction.

SYSTEM OPERATORS

Training

Only fully trained and qualified operators should be permitted to operate ammonia systems. Training is available through a number of trade organizations and professional societies. Some organizations that provide ammonia refrigeration education and training are listed in Appendix E, "Education and Information Resources."

Training on NH_3 System

In accordance with 40 CFR 68.54 (for Program 2 facilities) and 68.71 (for Program 3 facilities), the owner or operator of your facility must provide each employee, presently operating a process, training or test their competence in the facility's operating procedures. The operator is required to take refresher training at least every 3 years. In addition, after a major change in operations, the operator is required to be trained in any updated or new procedures prior to startup. For Program 3 facilities, the owner or operator must record the operator's identity, date of training and the method used to verify the operator understood the training.

Provide Awareness Training to Other Facility Personnel

Awareness training should be provided to other facility personnel who work within ammonia refrigerated areas. Awareness training of the hazards associated with ammonia accidents should be conducted in a manner that encourages immediate reporting of ammonia system damage and releases. Immediate awareness of a problem, or potential problem, can help ammonia operators quickly minimize and control any accidental releases.

Factors Causing Ammonia Releases

Equipment Failure	70%
Human Error	26%
Unusual Weather	2%
Other (e.g., vehicular impacts)	2%

It is important to realize that up to 96% of the anhydrous ammonia accidents reported in the Iowa, Kansas, Missouri, and Nebraska Risk Management Plans (1994-2004) may have been preventable through increased operator training, improved procedures, and better communication of lessons learned.

OTHER BEST PRACTICES

In addition to the "best practices" described earlier in this chapter, there are many other useful resources for those interested in researching additional best practice information. The following list is not comprehensive, yet we hope you find it to be helpful:

Factory Mutual's Data Sheet 12-61, Mechanical Refrigeration (May 2002)

Pressure Components:

- Piping and appurtenances in ventilated areas
- All refrigerant piping should be sleeved through walls and floors
- Armored guage glasses and flow check valves minimize losses
- 4 ft minimum clearance for refrigeration equipment

Preventative Maintenance:

- Preventive Maintenance Plans
- Effective water treatment program
- Purging of moisture and non-condensing gases
- Eddy current nondestructive testing of condenser and evaporator tubes

Instrumentation, Controls, Safeguards:

- Install various relief and check valves
- Install terminal cutout

The Air Conditioning/Heating/Refrigeration News (www.achrnews.com)

- Troubleshooting Restricted Air Flow (9/30/00)
- Maintenance and Efficiency of Evaporative Coolers (11/8/00)
- Technical Tips for Thermostatic Expansion Valves (12/6/00)
- Troubleshooting Inefficient Compressors (7/31/01)
- How a Dirty or Blocked Condenser Effects System Efficiency (8/29/01)
- How to Size Refrigeration System Piping (8/29/01)
- The Role of the Suction Line Accumulator (8/29/01)

International Institute of Ammonia Refrigeration (IIAR)

Equipment, Design, and Installation of Ammonia Mechanical Refrigerating Systems (ANSI/IIAR 2-1999)

- Section 5.11 Refrigerant Pumps
- Section 5.14 Pressure Relief Valves
- Section 5.17 Testing
- Section 6.2 Ventilation
- Section 7.3 Pressure-Relief Piping
- Section 7.5 Field Leak Testing
- Appendix A.2 Emergency Discharge Methods
- Appendix A.4 Discharge to Atmosphere

International Institute of Ammonia Refrigeration (IIAR) - cont.

Good Practices for the Operation of an Ammonia Refrigeration System (Bulletin No. R1, 1983)

- Chapter II, Section B, Preventive Maintenance
- Chapter II, Section C, Observation of System to Prevent Incident
- Chapter IV, Section E, First Aid Supplies Checklist
- Chapter VI, Section A, Informing Employees
- Chapter VI, Section B, Safe Work Practices and Procedures

Suggested Safety and Operating Procedures When Making Ammonia Refrigeration Plant Tie-Ins (Bulletin No. 107, 12/97)

- Section 6, Pumping Out Prior to Tie-In
- Section 8, Testing

Water Contamination in Ammonia Refrigeration Systems (Bulletin No. 108, 1986)

- Section VII, Detection of Water Contamination
- Section IX, Removal of Water From System
- Section X, Safety Precautions

IIAR Minimum Safety Criteria for a Safe Ammonia Refrigeration System (Bulletin No. 109, 10/97)

- Section 4, Safety Criteria
- Section 5, Frequency of Safety Inspections
- Section 7, Inspection Checklists

Start-up, Inspection and Maintenance of Ammonia Mechanical Refrigerating Systems (Bulletin No. 110, 3/93)

- Section 5.2, Pre-Start Up Safety Review
- Section 6.0, Inspection and Maintenance
- Appendix E, Stress Corrosion Cracking
- Appendix G, Typical Schedule for Inspection and Maintenance
- Appendix H, Sample Details for Register
- Appendix I, Sample System Log

Ammonia Machinery Room Ventilation (Bulletin No. 111, 10/91)

- Section 6.0, Operation and Maintenance
- Section 7.3 (and Appendix A), Minimum Ventilation Worksheet

Ammonia Machinery Room Design (Bulletin No. 112, 6/98)

- Section 4.2.1, Machinery Room Layout and Construction Features

International Institute of Ammonia Refrigeration (IIAR) - cont.

Identification of Ammonia Refrigeration Piping and System Components
(Bulletin No. 114, 9/91)

- Section 5.0, Marker Location
- Section 6.0, Visibility

Avoiding Component Failure in Industrial Refrigeration Systems Caused by Abnormal Pressure or Shock
(Bulletin No. 116, 10/92)

- Section 4.0, Trapped Liquid
- Section 5.0, Sudden Liquid Deceleration
- Section 6.0, Vapor Propelled Liquid
- Section 7.0, Normal or Not Normal

3.2 Property Security

Many accidents can be prevented by taking proper site safety precautions. Ammonia theft and vandalism have resulted in death, injuries, property damage, and chemical releases from ammonia storage facilities and refrigeration systems.

The following site security should be considered at existing facilities as well as at new sites. Some of these recommendations will depend on the type and size of your facility. Appurtenances containing anhydrous ammonia that are readily accessible to the general public tend to provide the most serious security risk.

Razor wire is a very effective deterrent.

- Educate employees about potential theft events and problems.
- Ensure that all outside ammonia vessels and storage areas are well lit.
- Know ammonia inventory to quickly identify missing quantities.
- Visually inspect all outside vessels and cylinders each morning (especially after weekends or other periods when the facility is unoccupied).
- Consider auditing the facility and setting up a valve protection program for critical valves that would cause a significant release if opened by mistake.
- Consider installing valve locks or fencing, especially for unattended outside vessels or cylinders.
- Install a check valve in the ammonia charging line close to the main control valve.
- Evaluate the benefits of installing lockable, quarter-turn ball or globe valves, or spring-loaded ball or globe valves in series with a manual valve in critical areas (e.g., ammonia supply connection, oil discharge container).
- Report thefts, signs of tampering, leaks, or any unusual activity to local law enforcement officials.
- Consider installing other theft deterrent measures such as **multi-lingual** warning signs, fences, walls, motion detector lights, motion detector alarms, security patrols, and/or video surveillance.

To assist in developing your Safety and Security Plans, you may want to look at the standards and recommended practices from other organizations. Listed below is a partial list of some resources that can provide information for developing security procedures or practices:

- *Standard for Site Security Services for Fire Loss Prevention*, National Fire Protection Assoc. (NFPA) - 601.

- *Responsible Care Employee Health and Safety Code Site Security Management Practice*, Chemical Manufacturers Association.

- The Agency for Toxic Substances and Disease Registry (www.atsdr.cdc.gov) provides a 10-step procedure to analyze, mitigate, and prevent public health hazards resulting from terrorism involving industrial chemicals.

- The American Society for Industrial Security (www.securitymanagement.com) develops educational programs and materials that address security concerns, including an online version of its magazine.

- The Center for Chemical Process Safety (www.aiche.org/ccps) develops engineering and management practices to prevent and mitigate consequences of catastrophic events involving chemical releases.

- The National Safety Council (www.nsc.org) provides general safety information on chemical and environmental issues.

- The National Security Council (www.energysecuritycouncil.org) is a national industry association that assists law enforcement agencies and energy companies in combating all types of criminal activity.

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CHAPTER 4 - WHAT TO DO WHEN THERE IS AN ACCIDENT

4.1 Be Prepared

Not knowing how to respond in an emergency often makes the situation worse. It is important to develop a strategic plan for emergency response and to practice the plan.

Ammonia Release after a facility explosion.

In accordance with 40 CFR 68.95, every Program 2 and Program 3 facility is required to have an emergency response program. *(Note: If a facility's employees are not responsible for responding to an accidental release, then the facility need not comply with 40 CFR 68.95. In this instance, the facility's emergency response program is to coordinate appropriate emergency responders and verify they are included in the community response plan.* ***It is the facility's responsibility to ensure there is a mechanism in place to contact local responders.****)* This emergency response **program** requires the following elements:

- **An emergency response plan**. Your emergency response plan must be specific to the operations and layout of your facility and must be maintained and kept at your facility. Each emergency response plan is to include:

  ✓ Procedures for informing the public and local emergency response agencies about accidental releases.

  ✓ Documentation of proper first-aid and emergency medical treatment for accidental human exposure.

  ✓ Procedures and measures for emergency response after an accidental release.

- **Procedures for using and maintaining emergency response equipment**.

- **Training for employees in their emergency responsibilities**.

- **Procedures to review and update the emergency response plan**.

See APPENDIX B for detailed information on Emergency Planning.

4.2 Report the Accident

Ammonia Cloud After a Release

No matter how well you implement best practices, planning, and security, accidents may still happen. Having a **well-rehearsed** emergency response plan in place will help alleviate much of the stress when an accident occurs.

When an accident does occur, it is essential that you notify the appropriate authorities **immediately*** so they can initiate a response if necessary to insure the protection of the public and the environment. Notification and response requirements are summarized in the following table:

Subject	Law and Regulation	Who to Notify	When
EPCRA Release Notification (≥ 100 pounds of anhydrous ammonia)	EPCRA 40 CFR 355	State Emergency Response Commission (SERC) Local Emergency Planning Committee (LEPC)	Immediately*
CERCLA Release Notification (≥100 pounds of anhydrous ammonia) & CWA Release Notification (≥ 100 pounds of anhydrous ammonia over a 24-hour period that enter "waters of the U.S.")	CERCLA 40 CFR 300 and 302 & CWA 40 CFR 117	National Response Center 1-800-424-8802	Immediately*
Notification of Slug Loading to POTW	CWA 40 CFR 403	POTW, State Hazardous Waste Authority, EPA Regional Waste Management Division Director	Immediately*
Notification of Hazardous Waste Discharge to Septic System	CWA 40 CFR 144	EPA Regional Underground Injection Control (UIC) Well Program, and state UIC Program	Immediately*
State Statutes	State Laws	State Environmental Agency	Varies

* "Immediately" is interpreted as "not to exceed 15 minutes after the person in charge has knowledge of the release." This interpretation is documented in A Legislative History of the Superfund Amendments and Reauthorization Act of 1986, Volume 2, October 1990.

Immediate Accident Reporting

Initial notifications of a release can be made by telephone, radio, or in person. In accordance with 40 CFR 302.6(a), a facility is to immediately report releases of more than 100 pounds of ammonia to the National Response Center at (800) 424-8802. Reporting should include the following:

- Chemical name or identity of the released substance;
- Indication of whether the substance is on the CERCLA Section 302(a) list;
- Estimated quantity of release;
- Time and duration of release;
- Medium or media into which the release occurred; and
- Whether release threatens waterways (reporting requirement of the Clean Water Act contained in 40 CFR 117.21).

In accordance with 40 CFR 355.40 a facility is to immediately report ammonia releases producing offsite exposure and exceeding 100 pounds to their Local Emergency Planning Committee (LEPC) and State Emergency Response Commission (SERC). The release report is to include:

- Chemical name or identity of all substances involved in the accident;
- Estimate of quantity of substances released to the environment; and
- Time and duration of release.

The facility owner or operator is also required to provide a **written Follow-up Emergency Notice** as soon as possible (and within seven calendar days) to their LEPC and SERC after a release that requires notification. The follow-up notice should include the following:

- An update of all previously provided information;
- Actions taken to respond to the release;
- Known or anticipated acute or chronic health risks associated with a release; and
- Advice regarding medical attention necessary for exposed individuals.

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CHAPTER 5 - WHERE THE GOVERNMENT COMES IN

5.1 Other Federal Requirements

When it comes to managing your facility in accordance to environmental laws, the Environmental Protection Agency's laws and regulations are not the only ones to consider. Federal statutes and regulations relevant to anhydrous ammonia process safety, accident prevention, emergency planning, and release reporting are summarized in the table below. Facilities are encouraged to review this information before a release occurs.

Statute and Regulation	Description	Source(s)
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, "Superfund") 40 CFR 302.6(a)	Hazardous Substance Release Reporting Releases equal to or greater than the reportable quantity of 100 pounds of ammonia must be immediately reported to the National Response Center (**NRC**).	National Response Center: (800) 424-8802
Clean Air Act (CAA) Section 112(r)(1) 40 CFR 68	**General Duty Clause** is applicable to facilities that store or use any amount of extremely hazardous substances, including anhydrous ammonia. The General Duty clause indicates facilities **"have a general duty... to identify hazards which may result from releases using appropriate hazard assessment techniques, to design and maintain a safe facility taking such steps as are necessary to prevent releases, and to minimize the consequences of accidental releases, which do occur."**	EPA Hotline: (800) 424-9346 or (703) 412-9810 or (800) 553-7672 (TDD)
Clean Air Act (CAA) Section 112(r)(7) 40 CFR 68	**Risk Management Program** Facilities having more than 10,000 pounds of anhydrous ammonia must develop a hazard assessment, a prevention program, an emergency response program, and submit a risk management plan to EPA.	EPA Hotline: (800) 424-9346 or (703) 412-9810 or (800) 553-7672 (TDD)

Statute and Regulation	Description	Source(s)
CAA 40 CFR 608	Regulates the use, recycling, and disposal of certain ozone-depleting substances (ODS) in applications including industrial processes and commercial refrigeration systems. The rules apply to systems that contain chlorofluorocarbon (CFC) or hydrochlorofluro-carbon (HCFC) refrigerants or refrigerant mixtures containing a CFC or HCFC. (Referenced here to emphasize that 40 CFR 608 **is not applicable to anhydrous ammonia refrigeration systems**.)	(800) 296-1996
Clean Water Act (CWA) 40 CFR 112	The CWA regulates the discharge of contaminants to surface water bodies from a point source. If a facility releases or discharges aqueous ammonia, then the CWA does apply and discharges of ammonia effluent would be regulated under state-specific NPDES permit programs. EPA's published ambient water quality criteria for ammonia is in EPA 822-R-99-014 (December 1999).	http://www.epa.gov/ost/standards/wqs/library
CWA 40 CFR 116.4	Ammonia is listed as a hazardous substance.	http://www.epa.gov/ost/standards/wqs/library
CWA 40 CFR 117.21	**Discharges** equal to or greater than the reportable quantity of 100 pounds of ammonia (that threaten waterways) must be reported to National Response Center (NRC) at (800) 424-8802. **Reporting** should be by the person in charge of the source vessel or facility.	National Response Center (800) 424-8802
CWA 40 CFR 122.26	**Stormwater Regulations** Regulates runoff from activities that take place at industrial facilities, such as material handling and storage that discharges industrial pollutants into nearby storm sewer systems and water bodies. This may adversely impact water quality and a permit may be required for this runoff.	http://cfpub.epa.gov/npdes/stormwater/indust.cfm

Statute and Regulation	Description	Source(s)
EPCRA 40 CFR 355.30	**Community Emergency Planning** Facilities that have ammonia equal to or greater than the threshold planning quantity (TPQ) of 500 pounds must report to their Local Emergency Planning Committee (LEPC) and State Emergency Response Commission (SERC), and comply with EPCRA Section 302 requirements. LEPC and SERC notification must be within 30 days of the date of exceedance of the TPQ and include information for the community emergency response plan. Facility must also appoint a liaison from the facility to the LEPC.	EPA Hotline: (800) 424-9346 or (703) 412-9810 or (800) 553-7672 (TDD)
EPCRA 40 CFR 355.40	**Emergency Release Notification** Releases equal to or greater than the reportable quantity of 100 pounds of ammonia must be immediately reported to the LEPC, SERC, or local emergency response personnel (911 in the case of transportation-related release) in accordance with EPCRA Section 304. Written follow-up is required within seven calendar days.	National Response Center: (800) 424-8802
EPCRA 40 CFR 370.20	**Hazardous Chemical Reporting** Facilities that have ammonia equal to or greater than 500 pounds must submit a Material Safety Data Sheet (MSDS) or chemicals list to their LEPC, SERC, and local fire department in accordance with EPCRA Section 311. Facilities must also comply with EPCRA Section 312's Tier I (aggregate) or Tier II (chemical specific)annual, March 1st, inventory reporting requirements (e.g., quantity, location, hazards, reactives). MSDSs or chemicals list must be provided within 3 months of chemical presence on-site, and then updated with any significant changes to quantity or process.	National Response Center: (800) 424-8802
EPCRA 40 CFR 372	**Toxic Chemicals Release Inventory** Manufacturing businesses with certain NAIC codes and ten or more employees that manufacture, process, or otherwise use ammonia above an applicable threshold quantity of 10,000 pounds must file annually a Toxic Chemical Release form with EPA and the state by July 1st. If more than 10,000 pounds of ammonia is added to a refrigeration system during a calender year it will trip the "otherwise used" criteria for filing. In accordance with Section 313, Annual Form A and Form R (unusual) reports are due July 1of each year.	EPA Hotline: (800) 424-9346 or (703) 412-9810 or (800) 553-7672 (TDD) TRI User Support: (202) 260-1531; www.epa.gov/tri and www.epa.gov/triexplorer

Statute and Regulation	Description	Source(s)
Occupational Safety and Health Act (OSHA) 29 CFR 1910.38a	**Employee Emergency Action Plans and Fire Prevention Plans** Ammonia incidents should be covered by these plans. This generally applies to facilities which plan to rely on off-site services for emergency response personnel and equipment. Anyone not part of the Incident Command system should evacuate the facility.	OSHA Public Information: (202) 219-8151, or www.osha.gov
OSHA 29 CFR 1910.111	**Storage and Handling of Anhydrous Ammonia** This standard **does not apply** to refrigeration plants that use ammonia solely as a refrigerant. This standard **does** apply to the design, construction, location, installation, and operation of any part of an ammonia distribution system (e.g., bulk storage facilities, distributors) including its associated pipelines and is typically applicable to ammonia retailers. This standard also **does** apply to other non-mechanical refrigeration systems users of ammonia (e.g., anhydrous ammonia used in the metal treating or reproduction industries).	OSHA Public Information: (202) 219-8151, or www.osha.gov
OSHA 29 CFR 1910.119	**Process Safety Management (PSM) Standard** Facilities that have ammonia equal to or greater than the threshold quantity of 10,000 pounds are subject to a number of requirements for management of hazards, including process hazards analysis and maintaining mechanical integrity of equipment. Note that external threats must be considered when conducting a process hazard analysis. The PSM standard is applicable to ammonia manufacturers and facilities with large ammonia refrigeration systems, but not applicable to retail facilities.	OSHA Public Information: (202) 219-8151, or www.osha.gov
OSHA 29 CFR 1910.120(q)	**Hazardous Waste Operations and Emergency Response Planning** Generally these requirements apply to employers who use anhydrous ammonia refrigeration systems. Requirements include personal protective equipment testing, levels of protective gear, compliance guidelines, and training curriculum guidelines. Generally applies to facilities that establish capability to offensively respond to an ammonia release as first responders.	OSHA Public Information: (202) 219-8151, or www.osha.gov

Statute and Regulation	Description	Source(s)
OSHA 29 CFR 1910.132, 1910.133, 1910.134, and 1910.138	**Personal Protective Equipment** Employers are required to provide personal protective equipment to employees who may be exposed to ammonia. Employees who wear a respirator during the course of their job, or who are expected to wear one during an emergency response situation, must follow the requirements of the respiratory protection standard.	OSHA Public Information: (202) 219-8151, or www.osha.gov
OSHA 29 CFR 1910.156	**Personal Protective Equipment** Requirements for the organization, training, and personal protective equipment of fire brigades whenever established by an employer.	OSHA Public Information: (202) 219-8151, or www.osha.gov
OSHA 29 CFR 1910.307	**Hazardous (Classified) Locations** There may be locations in an ammonia refrigeration system that are Class 1 Division 2 hazardous locations.	OSHA Public Information: (202) 219-8151, or www.osha.gov
OSHA 29 CFR 1910.1200	**Hazard Communication** Requires facilities using toxic and hazardous chemicals to evaluate potential hazards and communicate this information to the employees.	OSHA Public Information: (202) 219-8151, or www.osha.gov
Oil Pollution Act (OPA) of 1990 40 CFR 112, 33 CFR 154, 49 CFR 194, 30 CFR 254	**Spill Prevention, Control, and Countermeasure (SPCC)** Facilities storing oil above 1,320 aggregate gallons in containers larger than 50 gallons must prepare and implement SPCC plans. These plans need to address security elements such as locks, guards, access, lighting, and vandalism.	http://www.epa.gov/oilspill/index.htm
Resource Conservation and Recovery Act (RCRA) 40 CFR 264, 265, and 279.52	Anhydrous ammonia is not a listed hazardous waste (40 CFR 261). However, disposal of anhydrous ammonia requires hazardous waste characterization. Provided that a facility does not treat, store (> 90 days), or dispose of hazardous waste from anhydrous ammonia systems, the facility does not have to have a RCRA permit.	EPA Hotline: (800) 424-9346 or (703) 412-9810 or (800) 553-7672 (TDD) RCRA training modules: http://www.epa.gov/epaoswer/hotline/rmods.htm

5.2 State and Local Requirements

The federal statutes and regulations discussed above are the primary requirements. However, state and local governmental agencies may have their own (possibly more strict) requirements that are based on the federal laws. Therefore, be sure to check potentially applicable state and local government industrial, agricultural, chemical, and environmental requirements, including, but not limited to the following:

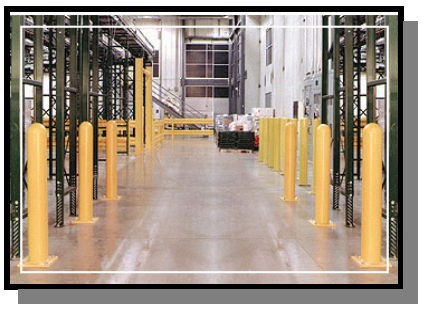
- Department of Agriculture
- Fire Marshal
- Environmental Division
- Local Building/Electrical Codes
- Boiler/pressure vessel inspector
- Department of Health
- State OSHA programs

Your State Emergency Response Commission will also be able to help you determine any applicable state and local requirements. Refer to the SERC map to locate your state's web site at: www.osp.state.or.us/oem/RelatedWebSites/states.htm

5.3 Audits

EPA conducts audits at facilities to determine if the facility has a Risk Management Plan that is in compliance with EPA's Risk Management Program. The EPA will then typically suggest modifications to a facility's Risk Management Program, leading to quality improvements. Typical examples of recommendations found during EPA audits include:

- Mount NFPA 704 (NH_3) placards on doors to compressor rooms and condenser/receiver areas;
- Install bollards at ammonia fill station to improve protection against vehicular traffic;
- Mechanically protect coils, valves, and pipes against fork lifts;



- Retest, calibrate, and replace ammonia sensors found inoperable during audit;

- Stock spill booms (specific for ammonia) to limit flow of released ammonia;
- Perform vibration testing and trend analysis on all motor/compressors every 6 months;
- Install check valves in charging line; and
- Add audible or strobe alarms tied into ammonia sensors to improve notification to workers.

Self Audits

In accordance with 40 CFR Part 68.58 and 68.79, facilities with Program 2 and 3 processes must evaluate their compliance at least every three years, documenting their findings and actions taken to address any problems. Facilities should consider EPA's Audit Policy, which encourages voluntary auditing and self-disclosure of violations of environmental regulations. EPA has negotiated numerous corporate-wide auditing agreements with companies to audit and correct violations across several environmental regulations. These approaches can offer a facility the opportunity to plan, finance, design, and implement practices that incorporate environmental compliance into operations.

EPA's EPCRA, RCRA, and CERCLA audit protocols, designed to assist the regulated community, are available at www.es.epa.gov/oeca/ccsmd/profile.html#audit.

5.4 Investigations

An incident investigation is a requirement of EPA's Risk Management Program, as contained in 40 CFR 68.60 and 68.81. (Note that these requirements are nearly identical to those under OSHA's Process Safety Management.)

For processes categorized as a Program 2 or Program 3 process, each incident that results in (or could reasonably have resulted in) a release must be investigated. The resulting investigation report should include the following information:

- Date of Incident;
- Date Investigation Began ($\leq$ 48 hours after the incident);
- Description of Incident;
- Factors that Contributed to Incident; and
- Recommendations Resulting from the Investigation.

The goal of an accident investigation is to determine the root causes or management system failures that ultimately caused the ammonia release. Efforts to determine the facts, conditions, circumstances, and probable causes of ammonia releases can help to reduce the likelihood of their recurrence. They can also minimize the consequences associated with future releases and make anhydrous ammonia refrigeration systems and operations safer for everyone.

Section 112(r)(6) of the Clean Air Act established an independent safety board known as the Chemical Safety and Hazard Investigation Board (the "Chemical Safety Board"). One of the objectives of the Chemical Safety Board is to investigate, determine, and report the facts, conditions, circumstances, and probable causes of an accidental release that results in a fatality, serious injury, or substantial property damage. For additional information concerning the Chemical Safety Board, visit www.csb.gov.

5.5 Inspections

Inspections typically provide an overview of a facility's compliance with applicable regulations. These are different from investigations, which specifically focus on events surrounding an incident and whether specific regulatory violations occurred.

Section 112(r)(1) of the Clean Air Act is known as the "General Duty Clause", which expands the range of activities EPA can undertake to promote chemical safety. Under the General Duty Clause, chemicals and threshold quantities are not listed. Therefore, ammonia refrigeration systems under 10,000 pounds (RMP Threshold Quantity) are subject to the General Duty Clause and may be inspected.

Ammonia refrigeration systems under 10,000 pounds (RMP Threshold Quantity) are subject to the General Duty Clause and may be inspected.

APPENDIX A - CLEAN AIR ACT (CAA) PREVENTION PROGRAM REQUIREMENTS

A.1 Determine Your Facility's Program Level

If you have determined that your facility is subject to 40 CFR Part 68, you will first need to ascertain whether your facility is subject to Program 1, Program 2, or Program 3. This appendix will guide you in making that determination as well as your corresponding responsibilities.

Your facility is subject to Program 1 if:

- Within the past 5 years of the date you submit your facility's Risk Management Plan (RMP), the process has not had an accidental release of a regulated substance that resulted in death or injury, or required restoration of an environmental receptor;
- Your process has worst-case release scenarios with no possible impact to public receptors; **and**
- Your process has emergency response procedures coordinated with local responders.

Your facility is subject to Program 2 if:

- It has any process that does not meet criteria for Program 1 or Program3. (Ammonia refrigeration processes will usually not be eligible for Program 2, because they are covered by OSHA Process Safety Management (PSM) standard codified at 29 CFR 1910.119.)

Your facility is subject to Program 3 if:

- It has any covered process in North American Industrial Classification System (NAICS) code 32211, 32411, 32511, 325181, 325188, 325192, 325199, 325211, 325311, 32532; or
- It has any covered process that does not meet the eligibility requirements for Program 1 **and** the process is subject to the OSHA PSM standard (29 CFR 1910.119).

If you aren't sure whether this rule applies to your facility or which Program (1, 2, or 3) applies, call the EPA HOTLINE at: (800) 424-9346 or (800) 553-7672 (TDD).

A.2 Program Responsibilities

Once you have determined your facility's program level, the following table summarizes what the corresponding requirements are.

Program Level	**Program 1** *40 CFR 68.12 (b)*	**Program 2** *(40 CFR 68.12 (c))* & **Program 3** *(40 CFR 68.12 (d))*
Management System	None required	Required
HAZARD ASSESSMENT		
Worst-Case Scenario	One for each covered process.	One worst-case representative of all regulated toxics and one representative of all regulated flammables.
Alternative Release	None required.	One for each regulated toxic and one representative of all flammables.
Five-Year Accident History	Program 1 facilities have certified no accidents.	Provide information for accidental releases from covered processes that resulted in: • On-site deaths, injuries, or significant property damage; or • Off-site deaths, injuries, evacuations, sheltering in place, property damage, or environmental damage.
Prevention Program	None required.	Required.
Emergency Response Program	Must ensure that facility is included in the community emergency response plan. For facilities with only flammables, coordinate response actions with local fire department.	Required if not included in Community Emergency Response Plan.
Submit a Risk Management Plan	Required.	Required.

The **Management System**, referred to in the table on the previous page, is a requirement for Program 2 and 3 facilities to oversee their Risk Management Program. In accordance with 40 CFR 68.15, facilities are required to do the following:

- Develop a management system to oversee implementation of the risk management program elements;

- Designate a qualified person or position with the overall responsibility for developing, implementing, and ensuring integration of the Risk Management Program elements; and

- Document names of people or positions and define lines of authority through an organizational chart or other similar document.

The **Hazard Assessment**, referred to in the table on the previous page, must include a worst case scenario for Program 1 facilities and an offsite consequence analysis (OCA) for each covered Program 2 or 3 process as follows:

- For worst-case and alternative release scenarios, potential exposures to human populations must be quantified and potential environmental damage must be identified;

- In accordance with 40 CFR 68.36, revised analyses and a revised Risk Management Plan is required within six months of changes in processes or any changes that increase or decrease the distance to an endpoint by a factor of two or more; and

- Worst-case and alternative release scenarios must be reviewed and updated at least once every five years.

Although not required, many facilities provide an accurate map showing these scenario distances to the Local Emergency Planning Committee (LEPC) for their planning purposes.

Facilities subject to EPA's Risk Management Program must also provide information for any accidental releases that resulted in deaths, injuries, significant property damage, evacuations, sheltering in place, or environmental damage.

Hazard Assessment Resources

- *Risk Management Program Guidance for Offsite Consequence Analysis*, available at http://www.epa.gov/ceppo/.
- Appendix E of EPA's *General Risk Management Program Guidance*, available at http://www.epa.gov/ceppo/.
- EPA's *Technical Background Document for Offsite Consequence Analysis for Anhydrous Ammonia, Aqueous Ammonia, Chlorine, and Sulfur Dioxide* (April 1999), available at http://www.epa.gov/ceppo/.
- RMP*Comp™, a software program developed by the National Oceanic and Atmospheric Administration (NOAA) and EPA, available at http://www.epa.gov/swercepp/tools/rmp-comp/rmp-comp.html.

Facilities may choose to use publically available or proprietary air dispersion models to do offsite consequence analysis. However, modelers should carefully review 40 CFR 68 requirements and EPA's *General Risk Management Program Guidance* to ensure compliance with the required conditions.

When building a **prevention program** on OSHA's Process Safety Management (PSM) standard or creating a new program, please consider:

- Assessing all hazards that could affect the public or the environment offsite;
- Integrating elements of the prevention program to ensure each change in any element in the program leads to review of other elements;
- Involving staff early on to secure their input in developing a concise and comprehensive program;
- Visiting facilities that have successful accident prevention programs to learn of their implementation procedures; and
- Applying inspection checklists to determine areas in need of improvement.

Your prevention program requirements may already be satisfied if your facility is in compliance with OSHA's PSM standard, which is the basis for the Risk Management **Program 3** with the addition of the offsite consequence analysis. Program 3 regulatory references are listed below.

Program 2 prevention requirements address PSM elements tailored to the less complex processes and chemical usage, and involve less documentation than Program 3. Program 2 processes demonstrate compliance by following industry standards and codes, engineering practices, and federal and state regulations. Program 2 regulatory references are listed below.

Prevention Program Regulatory Reference

Section	Program 2
68.48	Safety Information
68.50	Hazard Review
68.52	Operating Procedures
68.54	Training
68.56	Maintenance
68.58	Compliance Audits
68.60	Incident Investigation

Section	Program 3
68.65	Process Safety Information
68.67	Processes Hazard Analysis
68.69	Operating Procedures
68.71	Training
68.73	Mechanical Integrity
68.75	Management of Change
68.77	Pre-Startup Review
68.79	Compliance Audits
68.81	Incident Investigation
68.83	Employee Participation
68.85	Hot Work Permit
68.87	Contractors

Program 1 processes have no prevention program requirements.

Five-Year Accident History

In accordance with 40 CFR 68.42 and 68.168, a five-year accident history must be completed and included within a facility's Risk Management Plan (RMP) if the release caused at least one of the following:

- **On-site** deaths, injuries, or significant property damage; or
- Known **off-site** deaths, injuries, property damage, environmental damage, evacuations, or sheltering in place.

The facility's RMP must be modified to include a reportable accident within six months after its occurrence.

A Five-Year Accident History Report must include:

- **Date and Time**. Date and approximate time when accidental release began.
- **Chemical(s)**. Anhydrous ammonia.
- **Quantity Released**. Estimate of amount released (using at least two significant digits when possible).
- **Release Event**. Identify cause of release event (e.g., gas release, liquid spill, evaporation, fire, explosion).
- **Release Source**. Indicate release source(s) (e.g., storage or process vessel, piping, transfer hose, valve, pump).
- **Weather Conditions**. On-site weather station, or the nearest weather station, information (e.g., wind speed and direction, temperature, atmospheric stability class, precipitation). Also, many local airports will have and provide current weather conditions.
- **On-Site Impacts**. On-site effects including deaths, injuries, property damage.
- **Known Offsite Impacts**. Deaths, injuries, evacuated, sheltered, environmental damage.
- **Initiating Event**. Immediate cause of accident (e.g., equipment failure, human error, weather conditions, theft).
- **Contributing Factors**. Factors contributing to the release, but not the initiating event. For example, equipment failure, human error, improper procedures, over pressurization, upset condition, bypass condition, maintenance activity/inactivity, process design, unsuitable equipment, unusual weather conditions, management error.
- **Offsite Emergency Responder Notifications**. If known, indicate the emergency response agencies that were contacted (e.g., police, fire, EMS, LEPC, SERC, NRC).
- **Changes Resulting from Accident**. Measures taken to prevent recurrence (e.g., improved/upgraded equipment, revised maintenance, revised training, revised operating procedures, new process controls, new mitigation systems, revised emergency response plan, changed process, reduced inventory).

Emergency Response Program

A facility has the option to coordinate its response with its LEPC, with the intent that the **facility employees will not be responding to an accidental release** (40 CFR 68.90(b)). If this is the case, then the emergency response program must have mechanisms in place to notify emergency responders and the **facility is not required to comply with the requirements of 40 CFR 68.95**, as described below.

If the facility employees will be responding to the emergency, Program 2 and Program 3 facilities and its employees must follow the steps outlined in the emergency response program (40 CFR 68.95). The facility must have:

- Procedures for informing the public and local emergency response agencies about accidental releases;
- Documentation of proper first-aid and emergency medical treatment for accidental human exposure;
- Procedures and measures for emergency response after an accidental release;
- Procedures for using and maintaining emergency response equipment;
- Training for employees in their emergency response responsibilities; and
- Procedures to review and update the emergency response plan.

Emergency response plans developed to comply with other federal contingency planning requirements can meet the above requirements if they include the 40 CFR Part 68 required elements. The emergency response plan must be facility-specific. It must be maintained and kept at the facility.

For more information on emergency response, see Appendix B.

A.3 Additional Risk Management Plan Information

Registration

Each registration must include, but is not limited to:

- Facility Name and Address;
- Contact Person at Facility;
- Names and Quantities of Regulated Chemicals On-Site; and
- NAICS Code (information on NAICS codes may be found at: www.census.gov/epcd/www/naics.html. Click on NAICS under the "Business" heading.)

RMP Updates and Resubmittals

A facility must update and resubmit its RMP **within six months** of:

- A change that requires a revised off-site consequence analysis (40 CFR 68.36);
- A change that requires a revised hazard review or process safety analysis;
- A change that results in a change in program level of a covered process. The implementing agency for this regulation can ask the facility to revise the RMP under the audits provisions of 40 CFR 68.220. RMPs must be revised and resubmitted at least once every five years; or
- The date of an accident that meets the criteria for the five year accident history after April 9, 2004.

A facility must update and resubmit its RMP **within one month** of:

- A change of the emergency contact information.

Facilities no longer covered under the RMP rule, must submit a "de-registration" to EPA within six months of not being subject in accordance with the provisions of 40 CFR 68.190(c). (See Chapter 8 of RMP*Submit User 2004 Manual. The RMP Submit 2004 Software may be downloaded at: www.epa.gov/ceppo/. Click on "Chemical Preparedness and Prevention","Tools & Resources", "Databases and Software", "EPA Databases and Software", then "RMP Submit 2004.")

Additional RMP Resources

RMP guidance documents and training modules are available through the following sources:

- EPA's Chemical Emergency Preparedness and Prevention Office at www.epa.gov/swercepp/acc-pre.html;
- EPA's EPCRA Hotline at (800) 535-0202; or
- EPA's Technology Transfer Network at www.epa.gov/ttn.

Confidential Business Information

Facilities can claim some RMP information as confidential business information (CBI). Once claimed, EPA will make a determination of the validity of the facility's CBI claim. If EPA determines that the information is not CBI and has notified the facility, the information may be released. If EPA determines that the information is CBI, then a local emergency planning committee (LEPC) may be able to obtain the information under 40 CFR 2.301(h)(3). That regulation provides for sharing of CBI with state and local agencies having responsibilities under CAA or its implementing regulations. LEPCs can only gain access to CBI data under this rule if they can protect its confidentiality.

Under EPCRA Section 303(d)(3), LEPCs may compel an EPCRA Section 302 facility to provide any information necessary to develop and implement a community emergency plan. An EPCRA Section 302 facility must comply with such LEPC requests for information even if the facility has made a valid CBI claim.

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APPENDIX B - EMERGENCY PLANNING

B.1 Emergency Response Program Development

An emergency response program should be proactive and ongoing. EPA interprets "response" to be consistent with OSHA's HAZWOPER Standard (29 CFR 1910.120). OSHA defines emergency response as, "*a response effort by employees from outside the immediate release area or by other designated responders...to an occurrence which results, or is likely to result, in an uncontrolled release of a hazardous substance*." (Note that responders are designated for such tasks by the facility.)

Any spill of anhydrous ammonia, regardless of quantity, will require a "response" effort due to immediate ammonia volatilization, the hazardous nature of ammonia gas dispersing into the environment, and human health risks to on-site and off-site people.

Response Program Development should involve:

- Systematic Planning;
- Local Emergency Medical Service (EMS) Personnel; and
- Consideration of Counter-terrorism (CT) Measures.

Response actions during the first few minutes of an ammonia release are the most critical. They should not only be **planned**, but also **well rehearsed** to minimize the impact of a release. Facilities that take a comprehensive approach in developing a facility-specific emergency response program are better prepared to respond in a release event.

An emergency response plan outlines the action and equipment necessary for effective emergency response. However, a facility must conduct training, evaluate its program, maintain emergency equipment, and regularly coordinate with local agencies in order for an emergency response plan to be useful in an emergency.

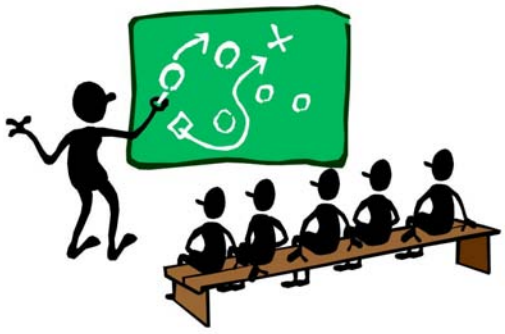
Systematic Planning

The following outline is an approach to an emergency response program. These proactive efforts should enable a facility to efficiently integrate facility-specific information, key technical and management resources, and relevant existing emergency response programs that may require coordination.

1. **Identify Federal, State, and Local Regulations Relevant to Emergency Responses for Ammonia Releases**
   Applicable regulations and guidance documents need to be identified for the development of your facility emergency response program. Facilities are encouraged to contact the EPA Hotline at 1-800-424-9346 or 703-412-9810 for assistance with identifying appropriate Federal and State regulations.

2. **The Program Development Team**
   A facility should select a team of employees who bring expertise from each of its functional areas. Ideally, the team members should also have varying degrees of emergency response responsibilities and experience within and outside the subject facility. A three-member team for a small facility may involve a couple of process operators who are cross-trained as emergency responders. A large facility with its own response team may need representatives from the following areas:

   - Maintenance;
   - Operations or Production Personnel;
   - Process or Upper Management;
   - Legal or Public Affairs;
   - Fire and Hazmat Response;
   - Environmental, Health, and Safety;
   - Security;
   - Emergency Coordinator; and
   - Labor Relations or Personnel.



3. Collect Existing Facility-Specific Documents and Information

Members of the development team should collect, review, and maintain copies of the following types of facility-specific materials:

- Site plans;
- Existing emergency plans or procedures;
- Submissions to the LEPC;
- Hazard evaluation and release modeling information;
- Hazard communication and emergency response training;
- Emergency drill and exercise programs;
- After-action reports and response critiques; and
- Mutual aid agreements.

The team may also identify related program materials from the following sources:

- Corporate and industry sponsored safety, training, and planning efforts; and
- Federal, state, and local government safety, training, and planning efforts.

Under CAA Section 112(r)(1), facilities have a general duty:

- to identify hazards which may result from releases using appropriate hazard assessment techniques;
- to design and maintain a safe facility, taking such steps as are necessary to prevent releases; and
- to minimize the consequences of accidental releases, which do occur.

Under this "General Duty Clause", facilities are responsible for ensuring that any process release can be effectively handled. Facilities relying on local responders must determine if the local responders have suitable equipment and training. If they do not, the facility must take steps to meet any needs (e.g., develop facility response capabilities, develop mutual aid agreements, hire response contractors, partially fund local responders).

4. Identify Emergency Response Gaps

Using the information collected, the team or a leadership subset should assess compliance with each emergency response program element of EPA's Risk Management Program (40 CFR Part 68). This assessment will expose gaps that exist.

Facilities in compliance with OSHA's HAZWOPER Standard will typically already satisfy most or all of EPA's requirements. An assessment of the gaps will help the team focus their efforts. (Note: Even if a facility is in compliance with OSHA's HAZWOPER Standard, submission of a Risk Management Plan to the EPA is required in accordance with 40 CFR Part 68.)

5. Tailor Emergency Response Program to Facility-Specific Hazards

Since hazards of using anhydrous ammonia are significant and all processes and chemicals at a facility pose a variety and range of hazards, it is necessary to tailor elements of an emergency response program to facility-specific hazards.

Some common considerations of facility-specific hazards include the facility's susceptibility to the following:

- Fires, spills, and vapor releases;
- Floods, temperature extremes, tornadoes, earthquakes, and hurricanes;
- Loss of utilities (including power failures and brown-outs);
- Train derailments, vehicle accidents, bomb threats, and other man-made disasters; and

- Chemical incompatibilities; e.g. ammonia and chlorine.

6. Integrate Emergency Response Program Across Existing Plans

Many federal statutes and regulations require emergency response planning. Development of plans for specific responses can leave personnel and emergency responders confused. Consistent with the Integrated Contingency Plan (ICP) Guidance's outline, many facilities have developed an ICP to consolidate emergency response plans into a single response plan. Here is a suggested ICP format:

Introduction

- Background Information
- Facility Overview
- Scope and Objective of ICP

Core Emergency Response Plan

- Essential procedures to initiate, conduct, and terminate an emergency response
- Procedures for emergency recognition, notification, and initial response (e.g., assessment, mobilization, implementation)

Supporting Annexes

- Key supporting information and information required for regulatory compliance
  - ✓ Emergency Response Teams
  - ✓ External Notification
  - ✓ Evacuation Assembly Areas
  - ✓ Emergency Response Equipment
  - ✓ Incident Command
  - ✓ SPCC Plans

The National Response Team (NRT), a multi-agency group chaired by EPA, published ICP Guidance in the Federal Register (61 FR 28642) on June 5, 1996. The guidance provides a mechanism for consolidating multiple plans, prepared to comply with various regulations, into a single, functional emergency response plan or ICP.

7. Prepare Written Emergency Procedures

Ammonia refrigeration facilities operate under conditions where a rapid shutdown can create further hazards if not done properly. In accordance with 40 CFR 68.52 (b)(4) and 40 CFR 68.69(a)(iv), facilities are required to prepare written emergency shutdown procedures and instructions for use by operators, emergency responders, and others. At a minimum, these materials should be developed for each of the most likely emergency scenarios (e.g., power failure, fire event). In particular, each facility should prepare specific materials for reference during an ammonia release. These materials should include the following:

- A manual of operating instructions,
- A system drawing showing the integral parts and their locations at the facility,
- The procedure to shut down the refrigeration unit for an extended period of time,
- Emergency shut-down procedures and subsequent start-up procedures,
- A table of the ranges of safe operating parameters measured at crucial meter locations,
- Safety procedures to be exercised at various locations, and
- Locations for recharging the system as well the specifications of the charge materials.

EPA suggests that a facility develop an emergency response chart (an example is provided below.) An emergency response chart may help emergency responders or the facility's security guard to close specific ammonia valves in the immediate vicinity of the ammonia detectors tripped by an ammonia release.

Example Emergency Response Chart

Ammonia Alarm		Emergency Action
Compressor Room 2W	➜	Close Valves C3 & C7
Compressor Room 2E	➜	Close Valves C8 & C9
Receiving Dock Area	➜	Close Valve A & Door 3
Warehouse Area A	➜	Close Valves W5 & W6
Warehouse Area B	➜	Close Valves W7 & W8

8. Develop and Maintain Emergency Tools

There are a number of tools that can be used to assist in a more orderly response during an emergency.

One such tool in the event of an accidental release of anhydrous ammonia is a wind sock. A wind sock can be an extremely helpful emergency tool as it can help determine wind direction and approximate wind speed at a glance. This information will help determine which direction the ammonia is heading and help estimate approximate distance of the release. Facilities should mount wind socks in appropriate places and incorporate their use in their emergency response plan.

Some facilities have developed posters and signs with information for employees and emergency responders. Development of these materials should ensure they will be effective for the intended people (e.g., other languages, appropriate reading level, locations of signs relative to hazards and emergency exits). For example: the significance of the position of the windsock and its implications relative to evacuation routes should be discussed with all staff members so that an orderly emergency response will result.

As mentioned previously, ammonia detectors with alarms are an essential emergency tool to help monitor all systems with anhydrous ammonia.

P&IDs, process flow diagrams, ladder/logic diagrams, or single line diagrams should be kept up to date and incorporated into operator training programs. Some facilities laminate the P&IDs and/or ladder/logic diagrams and then post them adjacent to the equipment and store a copy with on-site emergency response equipment and plans.

Role of Emergency Medical Service (EMS) in Planning

In an emergency, an integrated emergency medical response is critical. People seriously injured by a hazardous material have a greater chance of recovery when;

- Appropriate emergency treatment is provided by prepared EMS personnel at the scene;
- The patient is transported to a facility having the most appropriate personnel and technical resources; and
- Communication with the medical facility is open to relay information regarding the material impacting the patient.

EMS agencies are a crucial link in the community response system that responds to a facility incident. EMS personnel are often the first to arrive at an incident scene. They must be able to assess the nature of the hazard while attending to the immediate needs of victims.

The absence of EMS personnel in emergency response planning has resulted in the following types of problems:

- Incidents have been poorly managed by facility personnel and first responders;
- Communication channels have been ineffective and/or sometimes redundant between private and public sectors;
- Medical facilities have not been adequately prepared to treat or manage incoming patients involved in hazardous materials incidents; and
- Medical staff are not informed as to the lethal effects of a chemical release.

EMS personnel reinforce the importance of defining safe response scenarios, medical practices, and transportation guidelines in the event of an emergency. They will also be a critical link in the collaboration with other response agencies (e.g., police and fire departments) and hospitals.

EMS personnel should also participate in annual disaster drills and emergency plan reviews, helping to ensure that each emergency response plan is effective and benefits from lessons learned during other emergency events.

Your State Emergency Response Commission (SERC) and your Local Emergency Planning Committee (LEPC) play extremely important roles in Emergency Response Planning. Their roles are:

SERC

- Establish local emergency planning districts
- Establish procedures for handling public requests for information
- Appoint and oversee LEPCs
- Review LEPC emergency plans

LEPC

- Prepare and maintain a comprehensive emergency response plan for the district
- Provide hazardous chemical data to the public
- Respond or coordinate response

In accordance with 40 CFR 355.30, **facilities that use or store more than 500 pounds of anhydrous ammonia are required to notify the SERC and LEPC**. These facilities must appoint a liaison from the facility and work with the LEPC to include facility-specific emergency response information into the comprehensive emergency response plan.

Counter-Terrorism (CT) Measures

Before specifically considering CT, a facility should ensure their emergency plan is up to date. Simply adding CT materials to an outdated plan will not produce an effective emergency plan. For example, review of an emergency plan sometimes identifies outdated emergency contact information or process modification and facility construction that had not yet been addressed. After updating an emergency plan, a facility should consider adding information and procedures related to potential terrorist threats.

Each facility should review their emergency response plan based on the following considerations:

Emergency Contact Information
The National Response Center (NRC) is the sole Federal point of contact for reporting chemical spills/releases, including anhydrous ammonia. NRC Duty Officers take reports of actual or potential terrorism, then link emergency calls to the following:

- Department of Defense (for technical advice on dealing with weapons of mass destruction), and

- Federal Bureau of Investigation (to initiate Federal response actions and incident investigations).

Response Functions
An emergency response plan should clearly define responsibilities in an event. The plan should indicate how response functions change if an emergency occurs as the result of a known or suspected terrorist event. For example, an Incident Command System will likely transition to a Unified Command structure. The change in response leadership is typically necessary to accommodate emergency response efforts that involve mutual-aid partners, and State and Federal responders.

Hazards Analysis
While reviewing the hazards analysis portion of an emergency response plan, weapons of mass destruction (e.g., explosive, chemical, biological, and nuclear) should be considered. A facility could identify potential targets and their vulnerability to attack. Such a review should result in improvements to help ensure a facility is adequately protected. **The emergency response plan <u>should not</u> include details of the security system(s) as the information is generally made publically available**.

Mitigation Procedures

Procedures included in an emergency response plan should involve consequence management efforts. The mitigation activities should be designed to protect workers and the public from further exposure to hazards. In general, public health officials, EMS personnel, and criminal investigators should work together to identify and mitigate hazards following an event. The emergency plan could include a list of basic questions to ask victims, impacted emergency responders, and other individuals in the affected population. Information and effective communication are critical in identifying and mitigating effects of a terrorist incident.

Active and passive mitigation systems should be considered. Passive mitigation means equipment, devices, or technology that function without human, mechanical, or other energy input. Examples of passive mitigation include dikes and enclosed systems. Active mitigation means equipment, devices, or technologies that need human, mechanical, or other energy input to function. Examples of active mitigation include interlocks, shutdown systems, pressure-relieving devices, flares, emergency isolation systems, and fire protection systems.

The system design, location, operating procedures, and emergency response procedures should be taken into consideration when determining the mitigation system to use. The design of the mitigation system should consider the different factors that would influence the system operation and potential release scenarios.

B.2 Emergency Planning and Response Guidance

For further assistance in developing your emergency response program, the following materials are available:

- ***Criteria for Review of Hazardous Materials Emergency Plans*** *(NRT-1A)*, National Response Team, May 1988.
  Provides evaluation criteria for emergency response plans.

- ***Emergency Response Guidebook***, U.S. Department of Transportation, 2000.
  Lists over 1,000 hazardous materials and provides general hazard information and recommended isolation distances.

- ***Hazardous Materials Emergency Planning Guide*** *(NRT-1),* National Response Team, 1987.
  Designed to assist communities in planning for hazardous materials incidents, and includes useful information on planning teams, plan review, and ongoing planning efforts.

- Hazardous Materials Guide for First Responders, Federal Emergency Management Association and U.S. Fire Administration, 1998.
  Includes specific emergency response procedures for anhydrous ammonia releases.

- *LEPCs and Deliberate Releases: Addressing Terrorist Activities in the Local Emergency Plan*, EPA 550-F-01-005, August 2001.
  Discusses how counter-terrorism (CT) measures can be incorporated into emergency planning.

- *NIOSH Pocket Guide to Chemical Hazards,* NIOSH Publication No. 2000-130, July 2000.
  Provides ten relevant databases, including recommendations for chemical protective clothing, toxicologic chemical reviews, and the 2000 Emergency Response Guidebook.

- *Integrated Contingency Plan*, National Response Team, 61 FR 28642, June 5, 1996.
  Guidance on consolidating multiple plans into a single, functional emergency response plan that complies with various federal regulations.

B.3 Practicing Your Plan

In addition to planning, effective responses to ammonia releases require practice. Emergency responders must practice evaluation, isolation, containment and mitigation to prevent catastrophic releases. The following should be reviewed and practiced, as applicable, on a regular basis:

- **Typical Anhydrous Ammonia Accidents**

- **Exposure Limits For Ammonia**

- ***Risk Management Program* Requirements under Part 68 of the Clean Air Act**

- **Inspect Emergency Equipment**
  Emergency equipment should be inspected regularly to ensure respirators and other equipment are available, accessible, and usable. Air-purifying respirators must have appropriate and unexpired cartridges. They must only be used in an ammonia atmosphere less than 300 ppm. Self-contained breathing apparatus (SCBA) air should be suitable for the temperature in which the SCBA will be worn. Facilities should also periodically verify that onsite response personnel are trained and fit tested for the proper use of the emergency equipment.

Inspect Emergency Equipment Regularly

- **Establish Emergency Shutdown Procedures**
  Establish emergency shutdown procedures and instructions on what to do during and after a power failure.

- **Conducting Emergency Response Drills**
  Regular emergency response drills should be conducted at all facilities using ammonia refrigeration systems. All emergency responders (onsite and offsite) should "suit up" as part of each drill event.

  Several facilities are beginning to stage realistic response exercises with their local fire department or their hazmat emergency response team. The response drills should all be announced and involve preplanning to ensure they are realistic but different from recent drills.

  Facilities have used regular emergency response drills to maintain and increase public awareness of ammonia situations. Facilities may involve citizens in the immediate vicinity of their property. Emergency response and preparedness brochures may be distributed to nearby residences and businesses.

Emergency Responders are reminded that ammonia can be replaced - lives cannot! Offensive actions that threaten responder's lives should not be attempted unless other lives are in danger. The best practice is to safely evacuate an area until the ammonia dissipates.

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APPENDIX C - EMERGENCY FIRST AID FOR AMMONIA EXPOSURES

This is an Emergency First Aid Treatment Guide for Ammonia (CAS: 7664-41-7). This guide and similar information are available from the EPA at www.epa.gov/swercepp/.

Disclaimer
This guide should not be construed to authorize emergency personnel to perform the procedures or activities indicated or implied. Care of persons exposed to toxic chemicals must be directed by a physician or other recognized authority.

Signs and Symptoms of Acute Ammonia Exposure

Warnings:

- Ammonia is extremely corrosive to the skin, eyes, and mucous membranes.
- Contact with the liquified gas may cause frostbite.
- Caution is advised.

Inhalation of ammonia may cause irritation and burns of the respiratory tract, laryngitis, dyspnea (shortness of breath), strider (high-pitched respirations), and chest pain. Pulmonary edema and pneumonia may also result from inhalation. A pink frothy sputum, convulsions, and coma are often seen following exposure to high concentrations. When ammonia is ingested, nausea and vomiting may result; oral, esophageal, and stomach burns are common.

If ammonia has contacted the eyes, irritation, pain, conjunctivitis (red, inflamed eyes), lacrimation (tearing), and corneal erosion may occur. Loss of vision is possible. Dermal exposure may result in severe burns and pain.

Emergency Life-Support Procedures

Acute exposure to ammonia may require decontamination and life support for the victims. Emergency personnel should wear protective clothing appropriate to the type and degree of contamination. Air-purifying or supplied-air respiratory equipment should also be worn, as necessary.

Inhalation Exposure

1. Move victims to fresh air. Emergency personnel should avoid self-exposure to ammonia.

2. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support.

3. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures.

4. Transport to a health care facility.

Dermal Exposure

1. Remove victims from exposure, while avoiding self-exposure to ammonia.

2. Rinse the exposed area with generous amounts of water for **at least 15 minutes**.

3. **Warning: Do not attempt to neutralize with an acid wash; excessive liberation of heat may result**.

4. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If victim is not breathing, provide artificial respiration. If victim's breathing is labored, administer oxygen or other respiratory support. If no pulse is detected, provide CPR.

5. Remove contaminated clothing as soon as possible, after generously rinsing with water for at least 15 minutes. Be aware that ammonia may cause clothes to freeze to skin.

6. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures.

7. Transport to a health care facility.

Eye Exposure

1. Remove victims from exposure, while avoiding self-exposure to ammonia.

2. IMMEDIATELY flush eyes with lukewarm water for **at least 30 minutes**.

3. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If victim is not breathing, provide artificial respiration. If victim's breathing is labored, administer oxygen or other respiratory support. If no pulse is detected, provide CPR.

4. Obtain authorization and/or further instructions from the local hospital.

5. Transport victim to a health care facility.

Ingestion Exposure

1. Evaluate vital signs including pulse and respiratory rate, and note any trauma. If no pulse is detected, provide CPR. If not breathing, provide artificial respiration. If breathing is labored, administer oxygen or other respiratory support.

2. DO NOT induce vomiting or attempt to neutralize!

3. Obtain authorization and/or further instructions from the local hospital for administration of an antidote or performance of other invasive procedures.

4. Activated charcoal does not strongly bind ammonia, and therefore is of little or no value.

5. Give the victims water or milk: children up to 1 year old, 125 mL (4 oz or 1/2 cup); children 1 to 12 years old, 200 mL (6 oz or 3/4 cup); adults, 250 mL (8 oz or 1 cup). Water or milk should be given only if victims are conscious and alert.

6. Transport to a health care facility.

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APPENDIX D - DEFINITIONS OF ACRONYMS

ACGIH	American Conference of Government Industrial Hygienists
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute
ARTD/CRIB	Air, RCRA, and Toxics Division / Chemical Risk Information Branch
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing Materials
ATSDR	Agency for Toxic Substances and Disease Registry
CAA	Clean Air Act
CAS	Chemical Abstracts Service
CBI	Confidential Business Information
CEPPO	Chemical Emergency Preparedness and Prevention Office
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (or "Superfund")
CFCs	Chlorofluorocarbons
CFR	Code of Federal Regulations
CT	Counter-Terrorism
CWA	Clean Water Act
DOT	U.S. Department of Transportation
EMS	Emergency Medical Service
EPA	U.S. Environmental Protection Agency
EPA HQ	U.S. Environmental Protection Agency Headquarters
EPCRA	Emergency Planning and Community Right-To-Know Act
ERPGs	Emergency Response Planning Guidelines
FR	Federal Register
GARP	Georgia Ammonia Refrigeration Program
GPO	Government Printing Office
HAZMAT	Hazardous Materials
HAZWOPER	Hazardous Waste and Emergency Operations
HCFC	Hydrochloroflurocarbon
ICP	Integrated Contingency Plan
IDLH	Immediately Dangerous to Life and Health
IIAR	International Institute of Ammonia Refrigeration.
IRC	Industrial Refrigeration Consortium
ISO	International Standards Organization
LEPC	Local Emergency Planning Committee
MSDS	Material Safety Data Sheet
NAICS	North American Industry Classification System
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
NH_3	Ammonia
NOAA	National Oceanic and Atmospheric Administration
NRC	National Response Center
NRT	National Response Team
NSC	National Safety Council
NSCEP	National Service Center for Environmental Publications
NTIS	National Technical Information Service
ODS	Ozone-Depleting Substance
OPA	Oil Pollution Act
OSHA	Occupational Safety and Health Administration
OSHRC	Occupational Safety and Health Review Commission
OSWER	Office of Solid Waste and Emergency Response

P&IDs	Piping and Instrumentation Diagrams
PEL	Permissible Exposure Limit
PHA	Process Hazard Analysis
PRV	Pressure Relief Valve
PSM	Process Safety Management
RCRA	Resource Conservation and Recovery Act
RETA	Refrigeration Engineers Technicians Association
RMP	Risk Management Plan
RQ	Reportable Quantity
SCBA	Self-Contained Breathing Apparatus
SERC	State Emergency Response Commission
SIC	Standard Industrial Classification
SOPs	Standard Operating Procedures
SPCC	Spill Prevention, Control and Countermeasures
STEL	Short Term Exposure Limit
TDD	Telephone Device for the Deaf
TPQ	Total Planning Quantity
TRI	Toxic Release Inventory
UST	Underground Storage Tank

APPENDIX E - EDUCATION AND INFORMATION RESOURCES

This information is not intended to be all-inclusive or definitive, but it should provide a good starting point for finding relevant materials. Although the industry standards information represent good engineering practices, they are not subject to being "adopted" by EPA or OSHA. *The listings in Appendix E do not constitute EPA endorsement.*

Education and Training

- **Refrigerating Engineers Technicians Association (RETA)** offers self-study materials and a tiered certification/evaluation program for refrigeration technicians/mechanics. Call (847) 375-4738 or visit www.reta.com for additional information.

- **Industrial Refrigeration Consortium (IRC) at the University of Wisconsin-Madison** offers educational opportunities. Call (608) 262-8220 or visit www.irc.wisc.edu for additional information.

- **International Institute of Ammonia Refrigeration (IIAR)** offers ammonia refrigeration-related educational videos, short courses, technical publications, and an annual conference. Call (703) 312-4200 or visit www.iiar.org for additional information

- **Georgia Ammonia Refrigeration Program (GARP) at the Lanier Technical College** offers hands-on training oriented toward operators of industrial ammonia refrigeration systems, and PSM/RMP implementation classes. Call (770) 531-4500 or visit www.garpltc.com for additional information.

- **Garden City Community College** offers hands-on training oriented toward operators of industrial ammonia refrigeration systems, and PSM/RMP implementation classes. Call (620) 276-9520 or visit www.nh3gccc.com for additional information.

- **Garden City Ammonia Program** provides training for the industrial ammonia refrigeration operator for efficiency, safety, and compliance. Call (620) 271-0037 or visit www.ammoniatraining.com for additional information.

Industry Standards

- **American National Standards Institute (ANSI) at (202) 857-1110 or www.ansi.org**
  - ☞ Equipment, Design, and Installation of Ammonia Mechanical Refrigeration Systems (ANSI/IIAR 2, 1992)
  - ☞ Mechanical Refrigeration and Air Conditioning Installations Aboard Ships (ANSI/ASHRAE 26, 1996)

- **American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)**
  - ☞ ASHRAE Handbook (1998) covers refrigeration systems for applications other than human comfort.
  - ☞ Safety Code for Mechanical Refrigeration, ANSI/ASHRAE 15 - 1999 (not applicable to ammonia manufacturing plants) is available for purchase from ASHRAE at (800) 527-4723.

- **American Society of Mechanical Engineers (ASME)**
  - ☞ Boiler & Pressure Vessel Code (Section V Nondestructive Examination and Section VIII Pressure Vessels)
  - ☞ Refrigeration Piping Code (ASME B 31.5-1992)

- **Compressed Gas Association** G-2 Anhydrous Ammonia (1995).

- **Factory Mutual** Property Loss Prevention Data Bulletin 12-61 (April 1993) and Data Sheets 7-13 (1998).

- **International Institute of Ammonia Refrigeration (IIAR)** has published a number of reference materials and industry standard bulletins for the design, operation, and maintenance of ammonia refrigeration systems. Call (703) 312-4200 or visit www.iiar.org for additional information.

- **ISO 5149** (1993) (Mechanical Refrigerating Systems Used for Cooling and Heating - Safety Requirements) is available from ANSI at (212) 642-4900 or www.ansi.org.

- **Refrigeration Engineers Technicians Association (RETA)** has compiled and can provide relevant information about ammonia refrigeration industry standards. The association is currently involved in working with other trade associations and the educational community through colleges to develop a “National Skills Standard” for an ammonia engine room operator. RETA can be contacted at (847) 375-4738.

Information Sources

- The **Center for Disease Control's Emergency Preparedness and Response** website is: http://www.bt.cdc.gov/

- **EPA's Chemical Emergency Preparedness and Prevention Office (CEEPO)** can provide the following:
  - ☞ Chemical Safety Alert regarding Hazards of Ammonia Releases (refer to Appendix H of this manual).
  - ☞ General advisory on ammonia (OSWER 91-008.2 Series 8 No. 2) at www.epa.gov/ceppo/add-his.html.
  - ☞ Risk Management Plans for participating anhydrous ammonia facilities at www.epa.gov/ceppo/lepclist.htm.
  - ☞ Model Risk Management Program for ammonia refrigeration facilities available at www.epa/gov/swercepp/acc-pre.htm#modelplans/.

- **EPA's National Compliance Assistance Clearinghouse** offers a single repository of directories to Federal, State, local, and other compliance assistance providers at www.epa.gov/clearinghouse or (202) 564-7071.

- **EPA's National Response Center (NRC)** serves as the sole federal point of contact for reporting all oil, chemical, and other discharges in the environment anywhere in the United States and its territories. The NRC phone number is (800) 424-8802. Additional NRC information is available at www.epa.gov/oilspill/.

- **EPA's RCRA/UST, Superfund and EPCRA Hotline** for a wide variety of technical assistance materials and answers to specific questions at (800) 424-9346 or (703) 412-9810; also www.epa/gov/ epaoswer/hotline.

- **Industrial Refrigeration Consortium (IRC) at the University of Wisconsin-Madison** offers refrigeration-related resources. Call (608) 262-8220 or visit www.irc.wisc.edu for additional information.

- **National Service Center for Environmental Publications (NSCEP)** at (800) 490-9198 and www.epa.gov/ ncepihom/index.html.

- **National Technical Information Service (NTIS)** at (800) 553-6847 or (703) 605-6000 and www.ntis.gov.

- **Nationwide database** of LEPCs and SERCs can be found at the Right-to-Know network www.rtknet.org/lepc.

- **OSHA** can provide the following:
  - ☞ Ammonia refrigeration and process safety at www.slc.osha-slc.gov/SLTC/ammoniarefrigeration/index.html.
  - ☞ Searchable database providing accident summaries at www.osha.gov/oshstats.
  - ☞ Hazard information bulletins are available at www.osha-slc.gov/dts/hib/.
  - ☞ Standard interpretations and compliance letters specifically relevant to anhydrous ammonia facilities, including: *Ventilation for an Anhydrous Ammonia Refrigeration System*, *Training for Plant Maintenance Personnel and HAZWOPER*, *Back-Welding of Threaded Connections in Anhydrous Ammonia Service*, *Respiratory Protection for Anhydrous Ammonia Storage Installations*, and *Fires Involving Spills or Releases of Hazardous Substances* are available at www.osha-slc.gov/OshDoc/Interp_data/.

- **Occupational Health and Safety Engineering Data Sheet 4-04** (anhydrous ammonia) at www.govonca3.gov.o.ca/lab/main.htm

- **Occupational Safety and Health Review Commission (OSHRC)** posts OSHA decisions that are keyword searchable by year at http://www.oshrc.gov/decisions/decisions.html.

- **U.S. Government Printing Office (GPO)** at (202) 512-1800 or www.gpo.gov.

References

Accident Prevention and Emergency Preparedness for Agricultural Anhydrous Ammonia Systems, U.S. Environmental Protection Agency, Region 6 Response and Prevention Branch, October 2001.

Ammonia Data Book, International Institute of Ammonia Refrigeration, 1997.

Ammonia Refrigeration Piping Handbook, International Institute of Ammonia Refrigeration), 2000.

Ammonia Refrigeration: A Perspective from 75 Years of Experience, Milton Garland, Frick Company, NH_3 News (A publication of the International Institute of Ammonia Refrigeration), Fall 2000.

Anhydrous Ammonia Theft, U.S. Environmental Protection Agency, EPA-F-00-005, March 2000.

Annual Report on Enforcement and Compliance Assurance Accomplishments in 1999, U.S. Environmental Protection Agency, EPA 300-R-00-005, July 2000.

ANSI A 13.1-1981^R 1985, Scheme for the Identification of Piping Systems, American National Standards Institute (ANSI), New York, NY 10036.

ANSI K61.1, 1999, Standards for the Storage and Handling of Anhydrous Ammonia, American National Standards Institute (ANSI), New York, NY 10036.

ANSI/IIAR 2-1992, Equipment, Design, and Installation of Ammonia Mechanical Refrigeration Systems, American National Standards Institute (ANSI), New York, NY 10036, and International Institute of Ammonia Refrigeration (IIAR), Washington, DC 22036.

Chemical Accident Prevention and the Clean Air Act Amendments of 1990, U.S. Environmental Protection Agency, EPA 550-F-96-004, May 1996.

Chemical Accident Prevention: Site Security, U.S. Environmental Protection Agency, EPA 550-F-00-002, February 2000.

Chemical Accident Risks in U.S. Industry - A Preliminary Analysis of Accident Risk Data from U.S. Hazardous Chemical Facilities, James C. Belke, U.S. Environmental Protection Agency, September 25, 2000.

Chemical Safety Network Publications, National Service Center for Environmental Publications.

Clean Air Act Section 112(r), U.S. Environmental Protection Agency, EPA 550-F-96-005, May 1996.

Compliance Assistance Activity Plan, Fiscal Year 2001, U.S. Environmental Protection Agency, EPA 305-R-01-002, April 2001.

Control and Pollution Prevention Options from Ammonia Emissions, U.S. Environmental Protection Agency, EPA 456-R-95-002, April 1995.

Create Your Own Workshop: Ammonia Risk Management Program "Plan in Hand" Training for Small Businesses, U.S. Environmental Protection Agency.

Criteria for Review of Hazardous Materials Emergency Plans (NRT-1A), National Response Team, May 1988.

Emergency Response Guidebook, U.S. Department of Transportation, 2000.

Explosion in Cold Storage Kills Fire Fighter, Thomas J. Klem, National Fire Protection Association Journal, March 1985.

Hazardous Materials Emergency Planning Guide (NRT-1), National Response Team, March 1987.

Hazardous Materials Guide for First Responders, Federal Emergency Management Agency and United States Fire Administration.

Hazardous Substance Fact Sheet, New Jersey Department of Health and Senior Services, June 1998.

Hazards of Ammonia Releases at Ammonia Refrigeration Facilities (Update), U.S. Environmental Protection Agency, EPA 550-F-01-009, August 2001.

IIAR Bulletin 114, 9/91, Guidelines for Identification of Ammonia Refrigeration Piping and System Components, International Institute of Ammonia Refrigeration.

Incentives for Self-Policing: Discovery, Disclosure, Correction and Prevention of Violations, 60 FR 66706, December 22, 1995.

Integrated Contingency Plan, National Response Team, 61 FR 28642, June 5, 1996.

LEPCs and Deliberate Releases: Addressing Terrorist Activities in the Local Emergency Plan, U.S. Environmental Protection Agency, EPA 550-F-01-005, August 2001.

Leveling the Playing Field: Eliminating the Economic Benefit of Violating Environmental Laws, U.S. Environmental Protection Agency, EPA 300-F-00-002, May 2000.

Loss Prevention Data Bulletin 12-61, Factory Mutual, April 1993.

Material Safety Data Sheets (English and Spanish), Tanner Industries, Inc., 2001.

Multimedia Environmental Compliance Guide for Food Processors, U.S. Environmental Protection Agency, EPA 305-B-99-005, March 1999.

NIOSH Pocket Guide to Chemical Hazards and Other Data Bases, National Institute for Occupational Safety and Health, DHHS Publication No. 2000-130, July 2000.

Owners, Operators of Stationary Sources Must Comply with Clean Air Act's "General Duty" Clause, U.S. Environmental Protection Agency, EPA 300-N-98-006, August 1998.

Preventing Accidental Releases Under the Clean Air Act, Kansas Small Business Environmental Assistance Program, November 1999.

Recent Changes to the Risk Management Program Rule, U.S. Environmental Protection Agency, EPA 550-F-98-022, December 1998.

Risk Management Planning: Accidental Release Prevention, Final Rule: Clean Air Action Section 112(r), U.S. Environmental Protection Agency, EPA 550-F-96-002, May 1996.

Risk Management Program (RMP) Audit Program, U.S. Environmental Protection Agency, EPA 550-F-00-010, August 2000.

Risk Management Program Guidance for Ammonia Refrigeration (40 CFR Part 68), U.S. Environmental Protection Agency, EPA 550-B-00-006, May 2000.

RMPs Are on the Way!, How LEPCs and Other Local Agencies Can Include Information from Risk Management Plans in Their Ongoing Work, U.S. Environmental Protection Agency, EPA 550-B99-003, November 1999.

SARA Title III Fact Sheet, Emergency Planning and Community Right-To-Know Act, U.S. Environmental Protection Agency, EPA 550-F-93-002, January 1993.

Spill Prevention, Control and Countermeasure (SPCC) Regulation, 40 CFR 112, A Facility Owner/Operator's Guide to Oil Pollution Prevention, U.S. Environmental Protection Agency, EPA 540-K-98-003, July 1998.

Storage & Handling of Anhydrous Ammonia, Tanner Industries, Inc., May 1998.

Technical Background Document for Offsite Consequence Analysis for Anhydrous Ammonia, Aqueous Ammonia, Chlorine, and Sulfur Dioxide, Chemical Emergency Preparedness and Prevention Office, U.S. Environmental Protection Agency, April 1999.

Title III List of Lists, Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-To-Know Act (EPCRA) and Section 112(r) of the Clean Air Act, as Amended, U.S. Environmental Protection Agency, EPA 550-B-98-017, November 1998.

Training Module for Industrial Process Refrigeration Leak Repair Regulations Under Section 608 of the Clean Air Act, U.S. Environmental Protection Agency, EPA 300-B-96-001, February 1996.

What Belongs on An Ammonia Refrigeration P&ID, Daniel R. Kuespert, Ph.D., AcuTech Consulting, Inc., AcuSafe News, July 2000.

1999 Update of Ambient Water Quality Criteria for Ammonia, U.S. Environmental Protection Agency, EPA 822-R-99-014, December 1999.

Work with your Local Fire Department to Enhance Community Safety: The Cary Company, EPA 550-F-01-002, April 2001.

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APPENDIX F - ANHYDROUS AMMONIA HANDLING QUIZ

The following ten (10) questions can help an individual begin to realize the range of information and knowledge required to safely handle anhydrous ammonia systems and releases. Answers are on the next page.

1. At what concentration is a person able to smell the presence of anhydrous ammonia?
   a) 0-4ppm b) 5-50ppm c) 51-100ppm d) 101-150ppm

2. In accordance with 40 CFR 68, what is the threshold quantity for anhydrous ammonia?
   a) 10 pounds b) 100 pounds c) 1,000 pounds d) 10,000 pounds

3. Under the Clean Air Act Section 112(r)(1), facilities subject to this rule are:
   a) required to have the "general duty" to prevent releases and minimize consequences of accidental releases which might occur.
   b) are subject to EPA inspection if their ammonia refrigeration system contains <10,000 pounds of ammonia
   c) provide maintenance procedures in written form and implement them to maintain the ongoing integrity of process equipment
   d) only a) and b) are correct

4. If your facility uses more than 1,000 pounds of ammonia in a calendar year, you may be required to report annually on a Toxic Chemicals Release form.
   True or False?

5. A Process Hazard Analysis is required every 4 years on or before April 1st.
   True or False?

6. Which of the following information is the owner or operator of Program 3 facilities required to provide when verifying the completion of the operator's training.
   a) the operator's identity
   b) the method used to verify the operator understood the training
   c) the date of training
   d) a) thru c) are all correct

7. Your facility is required to notify the appropriate authorities when _____ pounds of anhydrous ammonia is released from your facility.
   c) ≥1 b) ≥10 c) ≥100 d) ≥1,000

8. A five-year accident history is required if your facility has had:
   a) On-site deaths, injuries, or significant property damage
   b) Known off-site deaths, injuries, property damage, environmental damage, evacuations, or sheltering in place
   c) a) and b) are both correct
   d) none of the above are correct

9. Facility Emergency Response Plans are required to provide details of the facility's security system(s).
   True or False?

10. If anhydrous ammonia splashes on someone's skin, the recommended first aid is to flush the exposed area with generous amounts of water for at least:
    a) 10 minutes b) 15 minutes c) 30 minutes d) 45 minutes

ANSWERS TO QUESTIONS ON PAGE F-1

1. At what concentration is a person able to smell the presence of anhydrous ammonia?
   b) 5-50ppm; See Page 1-2.

2. In accordance with 40 CFR 68, what is the threshold quantity for anhydrous ammonia?
   d) 10,000 pounds. See Page 2-1.

3. Under the Clean Air Act Section 112(r)(1), facilities are required to:
   d) only a) and b) are correct. See Page 3-1 and Page 5-8.

4. If your facility uses more than 1,000 pounds of ammonia in a calendar year, you may be required to report annually on a Toxic Chemicals Release form.
   False. See Page 3-9.

5. A Process Hazard Analysis is required every 4 years on or before April 1st.
   False. See Page 3-12.

6. Which of the following information is the owner or operator of Program 3 facilities required to provide when verifying the completion of the operator's training.
   d) a) thru c) are all correct. See Page 3-14.

7. Your facility is required to notify the appropriate authorities when _____ pounds of anhydrous ammonia is released from your facility.
   c) ≥100. See Page 4-2.

8. A five-year accident history is required if your facility has had:
   c) a) and b) are both correct. See Page A-5.

9. Facility Emergency Response Plans are required to provide details of the facility's security system(s).
   False. See Page B-10.

d) If anhydrous ammonia splashes on someone's skin, the recommended first aid is to flush the exposed area with generous amounts of water for at least:
   b) 15 minutes. See Page C-2.